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A REVIEW OF THE "DISCOVERY OF THE CRETACEOUS MAMMALIA."[1]

BY HENRY FAIRFIELD OSBORN.

IN July, 1889, I received a copy of the "Discovery of the Cretaceous Mammalia"[2] from Professor O. C. Marsh, and shortly afterwards wrote to the author calling attention to all the points in which it appeared to me he was mistaken, and suggested that he should revise the paper himself.

This was a year and a half ago. In the meantime Parts I. and II. of the "Cretaceous Mammalia" have been widely distributed, and the discoveries have been accepted without question by many who have no special knowledge of the Mesozoic mammals, and with considerable hesitation and criticism by those who have; I refer especially to the notices by Lydekker,[3] Lemoine,[4] Cope,[5] and Dames[6] It seems, therefore, that it is important to carefully review, in a manner that cannot be misunderstood either by the author or by others, what appears to me to be one of the most

[1] Presented to the Society of Morphologists, Boston, Dec. 30th, 1890; Academy of Natural Sciences, Philadelphia, Jan. 20th, 1891; Biological Society of Washington, Feb. 6th, 1891. Printed, with some alterations, in Proc. Phila. Acad.

[2] "Discovery of the Cretaceous Mammalia." O. C. Marsh, *American Journal of Science and Arts*, Parts I. and. II., July and August, 1889.

[3] Manual of Paleontology, Vol. II., p. 1268.

[4] Academy of Sciences, Paris, March 3d, 1890.

[5] AMERICAN NATURALIST, June, 1889, p. 490.

[6] *Neues Jahrb. f. Geol. Min. u. Pal.*, 1890, p. 141–143.

remarkable contributions to paleontology ever published. Criticism can, of course, be based only upon the published diagnoses, descriptions, and figures in comparison with our present general knowledge of these early mammals. Other evidence is promised by the author, and I venture to predict that it will confirm the greater part of the conclusions reached in this review.

First, as to extent and general character. The conspectus of the author impresses us that this fauna is not only highly varied, but contains forms which are mostly new to science. Four orders are believed to be represented: the Allotheria, Pantotheria, Marsupialia, and Insectivora. The author finds six families among the Allotheria alone, four of which are new; five new families in all. Sixteen new genera and twenty-seven new species are described. All of the types are isolated teeth, excepting those of Camptomus. With the exception of Halodon, Cimolomys, and Dipriodon, only one tooth of each species is described,—*i. e.*, from different parts of the jaws,—and we are given to understand that the remaining teeth, found with each, will be described in the memoir now in preparation by the writer, under the auspices of the United States Geological Survey.

Before this varied fauna is generally adopted in paleontological literature, let us examine the author's types and diagnoses, keeping in mind some of the characteristics of his work. These are: First, as regards other authors, not fully recognizing priority of discovery and nomenclature. Second, not taking advantage of readily available previous literature and description. Third, failing to recognize well-determined morphological characters, and founding extensive taxonomic systems upon various portions of the same animal, or upon imperfectly characterized types. The very fact that this work is done under the auspices and with the support of the National Survey renders it the more necessary to subject it to a full and fair spirited criticism; for the first characteristic of such work should be, not novelty, but permanent value.

Priority of Discovery and Nomenclature.—It is evident that the same fact cannot be discovered twice, in case the original discovery is authentic and properly published. It is well known

that Mr. J. L. Wortman discovered the first remains of Cretaceous Mammalia in 1882, a fact recorded by Professor Cope, as below:

"Mammalia, which have been looked for so long in vain in the Laramie beds, have at length been found. Mr. J. L. Wortman . . . now announces that he has found them in place and mingled with Dinosaurian remains in such a manner as to leave no doubt as to their contemporaneity." — AMER. NAT., Oct., 1882, p. 830.

"It has long been a reproach to paleontology that no remains of mammals were known from the Cretaceous formation. . . . For many years, therefore, special search has been made in various countries for Cretaceous mammals, but thus far almost invariably without success. . . . A second announcement was made by Cope in 1882, based upon a few fragmentary remains discovered by Dr. J. L. Wortman in Dakota. These fossils, although not found in place, were apparently from the Laramie formation." — *American Journ. of Science and Arts*, July, 1889, p. 81.

These papers under review amply confirm Mr. Wortman's discovery by describing many remains of the same mammal. Nevertheless the original discovery is made to appear very unimportant by depriving the mammalian type of its name. This type was a molar tooth, described as follows:

"*Meniscoëssus conquistus*, gen. et sp. nov.—But one specimen of this animal was found, and that is represented by two *molar* teeth and a distal extremity of a humerus. Were it not for the associated molar tooth, I should think that the *second* tooth might be that of a herbivorous reptile. It is probably a fourth

"It is now known that the tooth first described, and regarded as a premolar, is the tooth of a Dinosaurian reptile, as suggested by Cope, and not of a mammal. The name given, therefore, must apply to this alone. On this point the rules of nomenclature are clear and decisive. The imperfect molar

premolar. . . . *Char. gen.*—Fourth premolar with a compressed antero-posterior edge, which is studded with denticles; sides without ridges. Posterior molar rather small; crown with three longitudinal series of tubercles, of which many have crescentic sections." — AMERICAN NATURALIST, *loc. cit.*, p. 830.

tooth subsequently described and the fragment of a humerus are evidently mammalian, but *without a name.*" — *American Journal Science and Arts, loc. cit.*, p. 82.

It is very clearly stated by Prof. Cope in the above description and context that the first tooth—*i. e.*, the true molar—is the one upon which the mammalian determination is based; and that the *second* tooth —*i. e.*, the premolariform one—would have been considered reptilian except for its association with the first. This was clear to Lydekker, Lemoine, Osborn, and all subsequent writers, being repeated later with emphasis by Prof. Cope (AMER. NAT., July, 1884, p. 693).

FIG. 1.—*Meniscoëssus conquistus* Cope. Type. An inferior molar; x 2.

Previous Literature and Description.—There are obvious advantages in not consulting and referring to previous literature. It leaves the mind of a writer unprejudiced by previous opinions, and moreover lends to a contribution a quality of independence and originality. On the other hand, it deprives him of the benefit of past careful and laborious studies, and leads him into errors which might easily be avoided.

In case of the papers under review, previous literature has apparently escaped the attention of the author, except in the matter of nomenclature. The result is that some well-known principles which govern the extremely complex and confusing dentition of the Multituberculates are left out of consideration entirely, as well as some of the main characters of the dentition of the Mesozoic mammals in general, and some characters which enable us to distinguish between the teeth of mammals and those of reptiles and fishes. As regards the Multituberculates (Allotheria), it is now well known that their teeth show the following characters :

1. In the true molars, the rows of tubercles of one jaw fit into the longitudinal grooves of the other jaw. 2. In some families there are three rows of tubercles and two grooves in the upper molars, and two rows with one groove in the lower molars (Plagiaulacidæ); in other families there are conversely two rows above and three below (Stereognathidæ). 3. In every known species the last molar is invariably simpler than the penultimate molar, both as to length of crown and number of tubercles. 4. That the premolars are of two types: *a*, trenchant; *b*, tubercular. When tubercular, they can be distinguished from the molars by the absence of grooves, or closures of the grooves by tubercles. 5. The primary function of the incisors is to pierce the food; the secondary function is to facilitate the backward motion of the jaws, as in the rodents.

As regards the ordinal terms, Allotheria and Pantotheria, they have not as yet been defined or adopted.[7] The former is equivalent to the Multituberculata, which has been defined and is now in general use;[8] the latter is only used by the author in the reference of one genus.

A.—Multituberculate Forms (Allotheria).

1. *Cimolomys gracilis* (Pl. II., Figs. 1–4). Described as an upper molar; first referred to Tritylodontidæ (Owen), subsequently to new family Cimolomidæ.—Comparing this type with the upper molar of Neoplagiaulax,[9] Lemoine, we find it is a first upper molar of one of the Plagiaulacidæ Gill.

2. *Cimolomys bellus* (no figure). The type is referred to a distinct species of Cimolomys.—The description and measurements indicate that it is a second upper molar of *C. gracilis.*

3. *Cimolomys digona* (Pl. VII., Figs. 1–4). The type is described as an upper molar of a third species of this genus, referred to the Cimolomidæ.—It is an upper molar of one of the Plagiaulacidæ.

[7] See Osborn. "Mesozoic Mammalia," p. 257. The objections to Allotheria are that the term implies a sub-class equivalent in importance to the Prototheria or Eutheria, while the definition proposed by Professor Marsh is applicable to the *family* Plagiaulacidæ.

[8] See the works of Lydekker, Döderlein, Trouessart, Schlosser, Osborn, and others. This is probably a sub-order of the Monotremata.

[9] "Etude sur le Neoplagiaulax de la Faune Éocène inférieure, etc." Bull. d. l. Soc Géol. de France, Feb. 12, 1883, p. 259. Pl. VI., Fig. 17.

A premolar (Pl. VII., Figs. 13–16) is rightly described as an upper premolar, and correctly associated with this genus (compare Fig. 19, Lemoine [10]).

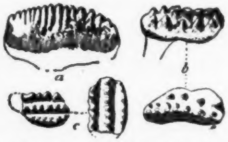


FIG. 1*b*.—Neoplagiaulax Lemoine. *c*, superior molar; *b*, superior premolar, 3–1.

4. *Cimolodon nitidus* (Pl. II., Figs. 5–8). The type is described as an upper molar representing a new genus and family, the Cimolodontidæ.—Comparing it with the lower molars of Ptilodus [11] Cope, it is evident that the type is a first lower molar of one of the Plagiaulacidæ.

5. *Nanomys minutus* (Pl. II., Figs. 9–12). The type is described as a last upper molar of the left side, and referred to the Cimolodontidæ.—A comparison with Ptilodus shows that it is a last lower molar of the right side, belonging to one of the Plagiaulacidæ.[12]

6. *Halodon sculptus* (Pl. III., Figs. 11–13). The type is a fourth lower premolar, rightly referred to one of the Plagiaulacidæ.

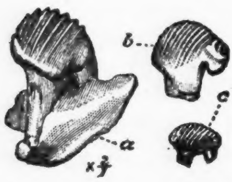


FIG. 2.—Halodon. Fourth inferior premolars of *a*, *H. sculptus*; *b*, *H. serratus*; *c*, *H. formosus*. After Marsh. All type specimens.

A superior incisor (Pl. III., Figs. 1–3) is referred to this species. It apparently belongs to a much larger form.

7. *Halodon serratus* (Pl. III., Figs. 14–17). The type is a fourth lower premolar, a smaller species rightly referred to one of the Plagiaulacidæ.

A superior incisor (Pl. III., Figs. 14–17) is referred to this species. It apparently belongs to a larger form.

It is a well-known fact that the upper molars of the Plagiaulacidæ have three rows of tubercles, while the lower molars have but two, and that the cusps of the lower rows fit into the valleys of the upper teeth. This is beautifully demonstrated in the author's own figures as here reproduced and rearranged in Figure 3: *a* is the type of *Cimolomys gracilis*, which fits upon *c*, the type of *Cimolodon nitidus;* while *b*, the type of *Nanomys minutus*,

[10] Op. cit., Pl. VI., Fig. 19*e*.

[11] This type (*C. nitidus*) has four internal and seven external tubercles; while *Ptilodus trouessartianus* has four internal and six external tubercles.

[12] "The Tertiary Marsupialia." Cope, AM. NAT., July, 1884, p. 694.

would probably be found to coincide similarly with the type of *Cimolomys bellus*, unfortunately not figured by the author. This gives us the characters of the molars of what was possibly a new genus (Cimolomys) of the Plagiaulacidæ, intermediate between Plagiaulax with three well-developed premolars, and Ptilodus with one large and one extremely small premolar. This genus cannot at present be defined, because, so far as we can compare the molars and premolars, they closely resemble in size and development the corresponding teeth of Ptilodus. The premolars of this genus are, of course, found in the species of Halodon. The premolar referred to *H. serratus* agrees best in size with the molars of *C. gracilis*.

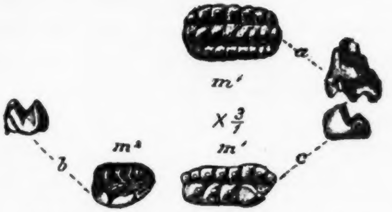


FIG. 3.—Upper and lower molars of Cimolomys. (Cimolomidæ), *a*, *Cimolomys gracilis*. (Cimolodontidæ), *b*, *Cimolodon nitidus*; *c*, *Nanomys minutus*. After Marsh. All type specimens.

The accompanying restoration of the upper and lower jaws of *Cimolomys gracilis* shows the various relationships of this animal as given in the above diagnoses by the author:

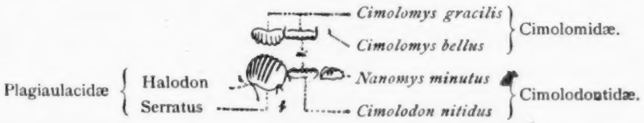


FIG. 4.—Upper and lower molars and premolars of ? Cimolomys, in position.

These relationships will probably be increased, rather than diminished, by future discoveries.[13] As it is, an upper and lower jaw referred to three families, five genera, and five species, is without precedent in paleontological literature.

8. *Dipriodon robustus* (Pl. II., Figs. 13–15). The type is probably correctly described as a last upper molar of the left side; it is referred to a new family, the Dipriodontidæ.

[13] See *Allacodon lentus*, which belongs either to this genus or to Meniscoëssus.

9. *Dipriodon lunatus* (Pl. II., Figs. 16–18). The type is rightly described as a first or second upper molar.—Keeping in mind the larger size and greater complexity of the more anterior molars, there is no ground for referring it to a new species.

10. *Tripriodon cœlatus* (Pl. II., Figs. 19–21). The type is described as a first upper molar, and is referred to a new family, the Tripriodontidae.—It resembles in the arrangement of its denticles the lower molars of Stereognathus, and, as shown below, is a last lower molar belonging to the genus Meniscoëssus Cope.

11. *Selenacodon fragilis* (Pl. II., Figs. 22–24). The type is described as an upper molar distinguished by crescentoid tubercles from the foregoing.—It is an anterior lower molar belonging to the genus Meniscoëssus Cope.

12. *Selenacodon brevis* (Pl. VII., Figs. 9–12). The type is described as an upper tooth, apparently from the left side.—As the accompanying figures show, it agrees in every detail, except the degree of wear, with the type of *Meniscoëssus conquistus* Cope; it is a lower molar, probably the last.

The lower incisor (Pl. VIII., Figs. 1–3) is probably correctly referred.

13. *Tripriodon caperatus* (Pl. III., Figs. 18–20). The type is correctly described as a lower incisor.—No ground is assigned for referring it to a new species. Similar incisors of smaller size (Pl. III., Figs. 21–22; Pl. VIII., Figs. 1–3) are referred respectively to *Tripriodon cœlatus* and *Selenacodon brevis*.

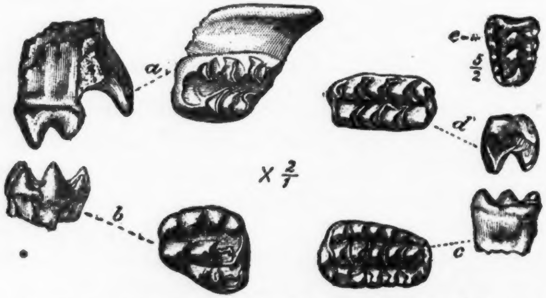


FIG. 5.—Upper and lower molars of Meniscoëssus. (Dipriodontidæ). *a*, *Dipriodon robustus*, crown view and end view; *d*, *D. lunatus*, crown view and end view. (Tripriodontidæ), *b*, *Tripriodon cœlatus*, crown view and end view; *c*, *Selenacodon fragilis*, crown view and end view; *e*, *S. brevis*. After Marsh. All type specimens, excepting *c*.

This collection of molars demonstrates that Meniscoëssus, like Stereognathus, belongs to a family in which the tubercles are crescentoid and arranged in two rows in the upper molars and three rows in the lower molars. This is admirably shown in the author's own figures as rearranged in Figure 5. *a*, the type of *Dipriodon robustus*, is seen to fit upon *b*, the type of *Tripriodon cœlatus*; *d* and *c* belong to old individuals, but the worn cusps and valleys coincide; they are respectively the author's types of *Dipriodon lunatus* and a molar referred to *Selenacodon fragilis*, as it agrees exactly with the type except in point of wear.

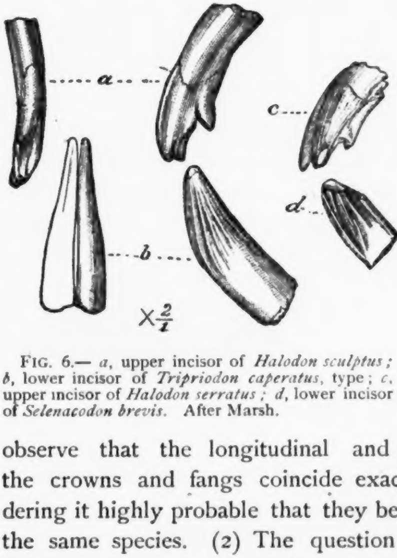


FIG. 6.— *a*, upper incisor of *Halodon sculptus*; *b*, lower incisor of *Tripriodon caperatus*, type; *c*, upper incisor of *Halodon serratus*; *d*, lower incisor of *Selenacodon brevis*. After Marsh.

The lower incisor, type of *Tripriodon caperatus*, corresponds in size with these molars; the two smaller incisors, referred to *T. cœlatus* and *Selenacodon brevis*, have the same shape and grooved sides. (1) When these incisors are placed side by side, as in Fig. 5, with the upper incisors referred by the author to *Halodon sculptus* and *Halodon serratus*, we observe that the longitudinal and transverse diameters of the crowns and fangs coincide exactly in measurement, rendering it highly probable that they belong to the same species. (2) The question is, Do these teeth belong to Halodon or Meniscoëssus? We observe that the lower incisor associated with *Halodon formosus* (Pl. VIII., Figs. 32–35) has the enamel confined to a band, as in Ptilodus and Neoplagiaulax. It is smooth. It is, therefore, probable that all these striated, completely enameled incisors belong to Meniscoëssus. (3) When, moreover, it is seen that these

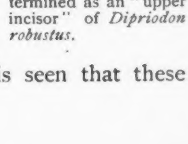


FIG. 7.—Tooth determined as an "upper incisor" of *Dipriodon robustus*.

incisors are far too large to be associated with the premolars of *H. sculptus* and *H. serratus*, we have further grounds for associating them with Meniscoëssus, with which they agree in size. The tooth (Fig. 7) assigned by the author as the upper incisor of *Dipriodon robustus* apparently belongs to a reptile. It is unlike any incisor hitherto found with the Multituberculata.

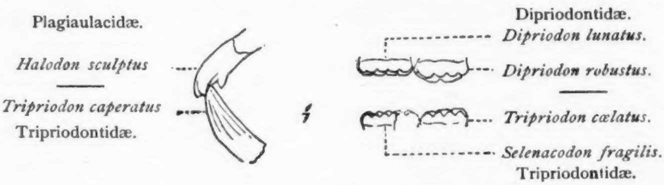


FIG. 8.—Upper and lower molars of Meniscoëssus in position. (Association of incisors with molars conjectural.)

The accompanying restoration is based upon the foregoing considerations, and show that, according to the author, the relationships of Meniscoëssus are as varied as those of its contemporary, Cimolomys, including three families, four genera, and seven species.

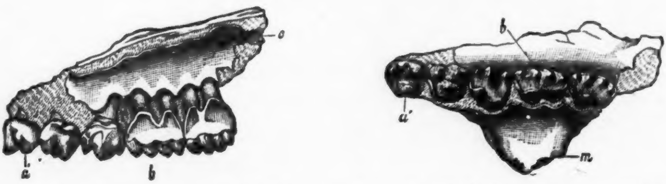


FIG. 8*a*.—*Ctenacodon potens* Marsh, 4–1. *a*, inner view of right upper jaw; *b*, ventral view of same; *a–b*, first to fourth premolar, as interpreted by Marsh. After Marsh.

14. *Allacodon lentus* and *A. pumilus* (Pl. VIII., Figs. 22–26–31). The types are described as upper molars of a genus related to Allodon and Bolodon, and referred to the Allodontidæ.—It is a universal characteristic of the molars of the Multituberculata that, as the grooves are adapted for fore and aft wear, the tubercles are arranged on the sides. In the type of Allacodon a tubercle stops the valley; these types are unadapted to fore and aft wear,—they are,

FIG. 9.—*Allacodon lentus*. After Marsh. Types.

therefore, premolars, and probably belong either with Meniscoëssus or Cimolomys, or possibly with some other genus the molars of which are not represented in this collection. Upper premolars of this type are seen in Chirox Cope; Bolodon Owen and Ctenacodon Marsh.

15. *Oracodon anceps* (Pl. VIII., Figs. 13–16). This type is rightly described as a premolar, but no grounds are given for considering that it belongs to a distinct genus and species.

FIG. 8*b*.—*Tritylodon Fraasii.* Supposed premolar.

16. *Camptomus amplus* (Pl. V., Figs. 1, 2). The type is a scapula with which are associated other bones, calcaneum, astragalus, interclavicle. No grounds are assigned for separating these remains from genera founded upon the teeth.—The astragalus bears the same proportion to the molar teeth of Meniscoëssus that we observe in Polymastodon; it is also apparently perforated. The affinities of these forms to the Monotremata have been observed by Cope; the coraco-scapular facet, therefore, strengthens the supposition that some of these bones at least belong to Meniscoëssus. In any case, they cannot be considered as good types.

This completes the Multituberculate forms.

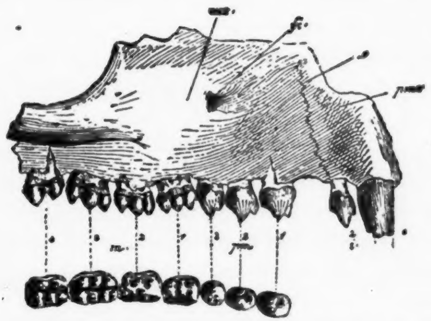


FIG. 10.—*Bolodon crassidens* Owen, 4–1. Outer surface of right maxilla and ventral view of premolars and molars.

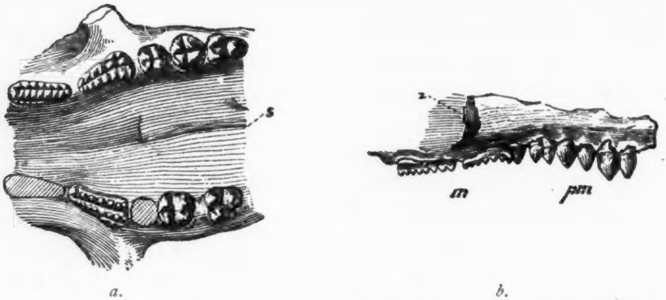


FIG. 11.—*Chirox plicatus* Cope, 3–2. *a*, palate with three premolars and two molars, *in situ* ; *b*, external view, right side.

B.—TRITUBERCULATE FORMS.

17. *Dryolestes tenax* (no figure). The type is a lower jaw with a mylohyoid groove, in which the number and character of the teeth "cannot be determined." The author's reference is provisional.

18. *Didelphops* (*Didelphodon*) *vorax* (Pl. IV., Figs. 1–3). The type is an upper molar, distinguished from Didelphys by intermediate tubercles.—This character does not separate it from the large number of Trituberculates with similar molars; the genus is, therefore, undefined at present. The other species, *D. ferox* and *D. comptus*, are also undefinable.

19. *Pediomys elegans* (Pl. IV., Figs. 23–25). The type is an upper molar.—It is not distinguished generically from Didelphodon.

20. *Cimolestes curtus* and *incisus* (Pl. IV., Figs. 8–18). The types are lower molars.—Like Didelphodon, these forms cannot be defined; they are tuberculo-sectorial.

It is evident that we have here remains of two distinct and probably new genera, which may be accepted without definition.

C.—INCERTÆ SEDIS.

21. *Stagodon nitor* (Pl. VII., Figs. 22–25). The types are a few teeth with single fangs, referred to a new family, the Stagodontidæ.

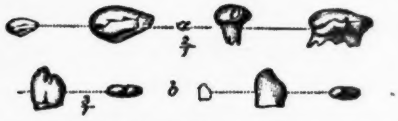


FIG. 12.—(Stagodontidæ), *a*, *Stagodon nitor*; *b*, *Platacodon nanus*. After Marsh. Types.

—They do not resemble the teeth of any known mammal, although described as having two fangs, which are, however, not shown in the figures. The premolar associated is distinctly mammalian.

22. *Platacodon nanus* (Pl. VIII., Figs. 4–12). The types are compared to the molars of Chrysochloris.—They do not bear the most remote resemblance to the molars of Chrysochloris or any other known mammal. Prof. Dames considers that they belong to the Cyprinoid fishes.[14]

The above types do not resemble in the most remote degree the molars in either the Multituberculate or Trituberculate series, —the only two mammalian series hitherto represented in all the discoveries of Mesozoic or Eocene times. Nor have they, as figured, any of the characteristics which we expect to find in mammalian teeth.[15] They should, therefore, be considered either reptilian or icthyopsidan; we cannot agree with the author that they are "evidently mammalian."

The above analysis may be summarized under the following heads. We find that the author has: 1. Separated parts which evidently belong together; *vide*, various teeth of Cimolomys and Meniscoëssus; 2. United parts which apparently or certainly belong together; *vide*, the large upper incisors with Cimolomys, the reptilian or fish molar of Stagodon with a mammalian premolar, the reptilian tooth as an upper incisor of Dipriodon; 3. Associated or identified reptilian or icthyopsidan teeth as mammalian; *vide*, Platacodon, Stagodon, and incisor of *D. robustus*.

The large Cretaceous fauna described by the writer is therefore seen to be principally composed of synonyms. We must eliminate:

[14] This author reaches very similar conclusions in regard to this paper. *Neues Jahr. f. Min. u. Geol.*, 1890, pp. 141–143.

[15] See H. G. Seeley. "On the Nature and Limits of Reptilian Character in Mammalian Teeth." Proc. Roy. Soc., April 4th, 1888, p. 129.

1. The terms preoccupied by other authors.

2. The terms founded upon different parts of the same animal, and thus largely preoccupied by the author himself.

3. The terms founded upon imperfect or indefinite types.

4. The terms founded upon reptilian or icthyopsidan teeth.

A. ALLOTHERIA.	=	A. MULTITUBERCULATA Cope. (In part.)
1. CIMOLOMIDÆ. *Cimolomys gracilis* " *bellus* " *digona* 2. CIMOLODONTIDÆ. *Cimolodon nitidus* *Nanomys minutus* 3. PLAGIAULACIDÆ. *Halodon sculptus* " *serratus* " *formosus*	=	1. PLAGIAULACIDÆ Gill. CIMOLOMYS Marsh; two or three species.
4. DIPRIODONTIDÆ. *Dipriodon robustus* " *lunatus* 5. TRIPRIODONTIDÆ. *Tripriodon cœlatus* " *caperatus* *Selenacodon fragilis* " *brevis*	=	? 2. STEREOGNATHIDÆ, fam. nov. MENISCOESSUS Cope; two species.
6. ALLODONTIDÆ. *Allacodon lentus* " *pumilus*		Probably preoccupied.
? Camptomus amplus *? Oracodon anceps*		Indefinite types or preoccupied.
? B. PANTOTHERIA. ? 7. DRYOLESTIDÆ. *? Dryolestes tenax*		Indefinite type.
C. MARSUPIALIA. *Didelphops vorax* " *ferox* " *comptus* *Cimolestes incisus* " *curtus* D. INSECTIVORA. *Pediomys elegans*		B. Order indeterminate = Creodonta, Insectivora or Marsupialia. DIDELPHOPS Marsh; two spec's. CIMOLESTES Marsh; ? species. Not defined.

E. INCERTÆ SEDIS. 8. STAGODONTIDÆ. *Stagodon nitor* *Platacodon nanus*	Founded upon reptilian or icthyopsidan teeth.

This reduces the Cretaceous mammals described in these two papers to one well-determined order or suborder, two well-determined families, and four or five genera, one of which can now be well defined (Meniscoëssus), while the remainder are probably distinct genera, which we may be able to define by the acquisition of more material (Cimolomys, Didelphops, and Cimolestes). There is no question that the majority of the remaining generic names are synonyms, although it is quite possible that some of the types described, such as Oracodon and Pediomys, may be found to represent distinct or new genera.

It may be said that this analysis has almost eliminated the work of the author. This unfortunately is what is necessary if we would render this contribution of any permanent value in paleontology. We are, then, left with a series of teeth which represent rare skill on the part of the collector, and are figured with remarkable accuracy by the draughtsman. A few points of interest upon the collection as a whole may be mentioned:

The Multituberculata. The preponderance of teeth belonging to members of this order would appear to indicate that it flourished during this period. Cimolomys represents a connecting form between Plagiaulax, Upper Jurassic, with three premolars, and Ptilodus of the lowest Eocene with two. The smallest species, *C. formosus*, apparently has as many grooves upon the fourth premolar as we observe in Ptilodus, and the first lower molar has even more tubercles than we find in the corresponding tooth of the Lower Eocene genus. These grooves and tubercles mark the stages of development, and it would appear that Cimolomys is not far removed from Ptilodus; this relation can only be determined by the discovery of additional teeth; we may find that Cimolomys has a large third premolar.

Another interesting fact is that Meniscoëssus does not belong with the Plagiaulacidæ, as has been generally supposed hitherto,[16]

[16] Cope, Osborn, Lydekker.

but should apparently be placed with Stereognathus (with which its resemblance in molar structure has always been recognized) in a distinct family, the Stereognathidæ, distinguished by the presence of two rows of tubercles in the upper molars and three in the lower, of the crescentoid pattern. The more numerous tubercles in Meniscoëssus would accord well with its more recent character.

There are thus apparently only two families of the Multituberculates represented here,—unless, as the author has suggested, Allacodon belongs to the Bolodontidæ. We have yet to find the successors of the Tritylodontidæ and predecessors of Polymastodon and Chirox of the Lower Eocene.[17]

As for the Trituberculate forms, there are evidently two distinct genera, which probably belong to different families. The types of Didelphops and Cimolestes closely resemble molars found respectively among the Mesodonta, the Creodonta, Insectivora, and Marsupialia. Their systematic position is, therefore, very uncertain from this evidence. They mark, however, a very great advance upon the Jurassic forms in tooth evolution. We find in Didelphops the earliest low-crowned tritubercular molar which has been obtained, with one or two intermediate tubercles, while the lower molar is the earliest quinquetubercular tooth known. The Cimolestes molar is tuberculo-sectorial, and presents a marked advance upon Jurassic tooth types, but has, nevertheless, a broad talon, with both the entoconid and hypoconid developed, whereas all Jurassic forms present the hypoconid only.

The bones of the appendicular skeleton present a number of very interesting points, some of which the author mentions. These are: the coracoid facet upon the scapula; the interclavicular. We note also the flat astragalus, without a neck, apparently perforated by an astragalar foramen,[18] and with a broad cuboidal facet as well the navicular facet. The calcaneum has a narrow sustentaculum.

[17] The nearest resemblance to Polymastodon is that observed in the striated lower incisors here copied in Figure 5. This genus will undoubtedly be found represented in these beds.

[18] This observation rests solely upon the figure. All astragali of the Lower Eocene display this foramen.

We look forward with great interest to Part III. of this series of papers, as this collection is a most valuable and interesting one; and the above review is not intended in any way to depreciate the importance of an increased knowledge of the Cretaceous Mammalia.

NOTES ON MESOZOIC MAMMALIA.[1]

BY O. C. MARSH.

I HAVE recently received from Prof. H. F. Osborn a pamphlet entitled "A Review of the Cretaceous Mammalia," which is intended as a criticism of two of my papers, and is a characteristic addition to his previous publications on Mesozoic mammals. It is difficult to take this review seriously, as it contains no new facts, and is mainly an application of the author's theories, which may, in part, prove to be true, but at present are without substantial basis. To attempt to refute all the assumptions he makes would involve a long discussion of known Mesozoic mammals, and take time from more important work. A brief notice of a few points, therefore, must suffice for the present.

Every one familiar with Mesozoic mammals knows that the author of this review has never collected any, has no specimens of the kind, and has only seen a part of those belonging to others, who have shown them to him as a matter of courtesy, in some cases even when an investigation was intended or in progress. Of more than a thousand specimens of Cretaceous mammals on which my investigations are based, he has not seen a single one, and no others are known except a few fragments. Of several hundred specimens of Jurassic mammals which I have secured in the west, he has seen perhaps one-tenth; while of other Mesozoic mammals from this country, he cannot have seen in all more than a half dozen specimens.

[1] As presented to the Academy of Natural Sciences, Philadelphia, April 14th, 1891. Published, with some alterations, in the Proceedings of the Academy.

Prof. Osborn's other qualifications for discussing Cretaceous mammals do not seem especially conspicuous. Certainly his papers on other Mesozoic mammals do not show that high degree of accuracy which a critic should put into them. One or two examples will make this evident.

He began this work in 1886 with borrowing two specimens of Dromatherium Emmons, and making a new genus of one of them, on insufficient grounds. In a characteristic manner, he commenced by criticising Emmons's work, especially one figure, but this he subsequently retracted. His own figures of one of these fossils agree neither with each other nor with the specimen, as a recent comparison shows.

He next turned his attention to the Mesozoic mammals in the British Museum, beginning with the Triassic Tritylodon from South Africa described by Owen. Again Prof. Osborn did not agree with the original authority, but announced in print that a most important point had not been appreciated by Owen : namely, a large parietal foramen, which showed that "the primitive Mammalia, of this family at least, had a pineal eye of some functional size and value,"—a most interesting discovery, if true. A reference to the specimen itself proved that there was no foundation whatever for the announcement, and Prof. Osborn was compelled to retract it (*Science*, Vol. IX., p. 92 and p. 538, 1887).

The results of Prof. Osborn's further study of the Mesozoic mammals in the British Museum were not considered important by some of the best authorities there, and some of his observations they disproved, in my presence, by referring to the fossils themselves. His figures of these specimens, moreover, are not accurate, and in some cases are misleading, as a single example will show. In his Mesozoic Mammalia, Plate VII., he gives a new figure of the type of Phascolotherium, but a comparison with the original specimen shows that this fine figure is erroneous in at least four important points : namely, the first incisor ; the crown of the last molar, which is wanting in the specimen ; the position of the dental foramen ; and the mylohyoid groove. His very objectionable method of regarding different isolated specimens as identical, and making a "composite" drawing of them, as repre-

senting a single type, led into other serious errors. This method, which belongs rather to metaphysics than to natural science, Prof. Osborn has again used in the present review, and with no better results.

This long review purports to discuss my first and second papers on Cretaceous mammals. The first thing that strikes the careful reader is the title he gives to these papers. My own title was a simple one, "Discovery of Cretaceous Mammalia," and it is only fair to expect, in an elaborate review, that the title, at least, will be correctly quoted. Instead of this, Prof. Osborn has added two other words, giving it a different meaning, but quoting it as mine: namely, "The Discovery of the Cretaceous Mammalia." He read this review in no less than three different cities, and published an abstract elsewhere, yet apparently had no time to read my title of four words carefully enough to quote it correctly. A small matter, perhaps, but proof positive of careless work.

The next point to be noticed is that my order Allotheria is rejected as not having been defined, and a later term, Multituberculata, is adopted because it has been defined. This direct statement of Prof. Osborn is incorrect, as my order was defined when proposed in 1880 (*Am. Jour. Sci.*, Vol. XX., p. 239). The cumbersome term Multituberculata was not defined when proposed by Cope in 1884, but Prof. Osborn kindly attempted this in 1888. His definition, unfortunately, does not include some characteristic forms of the group, but takes in accurately the genus Mastodon, although this great Proboscidian can hardly be considered a Marsupial.

By way of instruction, Prof. Osborn is good enough to indicate what he terms "the main characters of the dentition of the Mesozoic mammals in general, and some characters which enable us to distinguish between the teeth of mammals and those of reptiles and fishes." This is a most promising statement, but loses some of its force when we find that it has not saved him from precisely these mistakes, either in his previous papers or in the present review, as I show later.

He is scarcely more fortunate in his announcement of what he regards as the well-known characters of the teeth of one group,

the Allotheria. I have probably seen all the Mesozoic mammals examined by Prof. Osborn in Europe, and likewise quite a number of others, including the type of Stereognathus. He is certainly wrong in several of his main conclusions, and in others there are many facts against him.

A more correct restatement of some of the characters of this group would be as follows:

1. No true Plagiaulacidæ are known with three rows of tubercles on the upper molars.

2. No Allotheria are known with certainty to have three rows of tubercles on the lower molars.

A careful study, moreover, of the known specimens of the true Plagiaulacidæ would have shown him the strong probability, at least, that the genus Bolodon, which he makes the type of a distinct family, is based on the upper jaws of Plagiaulax; also, the probability, as I have before suggested, that the type of Stereognathus, of which he makes another of his numerous families, is an upper jaw, although described as a lower one.

Bearing in mind these points, Prof. Osborn's main criticisms are seen to be without foundation, and the errors largely his own. By substituting theory for the actual study of well-preserved specimens, he has unwittingly placed on record the fact that he cannot tell upper from lower teeth in Mesozoic mammals, nor the teeth of reptiles and fishes from those of mammals.

There is now conclusive evidence that the Cretaceous molar teeth with three rows of crescents belong to the upper series, as I described them. Prof. Osborn's reference of these to the lower jaw is based merely on theory, with only conjecture to support it. The same fundamental error runs through most of his reviews, and measures the value of his criticism.

Another unfortunate error of Prof. Osborn was mistaking the tooth of a reptile for the premolar of a mammal, and not only describing and figuring it as such, but making this a basis for using a generic name (Meniscoëssus), against well-known laws of nomenclature. This supposed premolar he figures and describes in his Mesozoic Mammalia (p. 218), and has elsewhere strongly defended its mammalian character. There is not a particle of

evidence of this, as every one familiar with similar specimens knows.

Notwithstanding this inexcusable mistake, Prof. Osborn ventures to assert in his review that a tooth, which I described and figured as a molar of a mammal, Stagodon, has but a single fang, does "not resemble the teeth of any known mammal," and that the genus was "founded upon reptilian or ichthyopsidian teeth." I distinctly stated that this tooth has two fangs, and the bases of these were indicated in one of my figures. Moreover, several well-preserved specimens since obtained show two distinct roots, and other features which prove these teeth mammalian beyond doubt.

In his Mesozoic Mammalia (p. 221) Prof. Osborn describes and figures as a premolar a specimen which is now almost certainly known to pertain to a fish, and not to a mammal. I have a very similar specimen from the same locality, which is pronounced the same species by those who have examined both. This I purchased many years ago of a well-known collector in Stuttgart, who called it a mammal tooth. When investigating Mesozoic mammals later, I examined this specimen with care, and found it to be made up of two portions of fish teeth (Hybodus) neatly cemented together, making four cones on a quadrate base, as in the fossil Prof. Osborn so carefully described. A friend who saw my specimen here has since sent me from Europe drawings of a third supposed mammal tooth from the same locality (Diegerloch), which he considers the same as mine. The drawings are characteristic, and indicate another specimen of apparently the same sort. Others are probably in existence, as the demand for Mesozoic mammals is great, and the supply has hitherto been limited.

One or two points more should be mentioned about Prof. Osborn's work on Mesozoic mammals: namely, his habit of replacing, on insufficient grounds, scientific names, especially those of families and genera, by other names of his own; also, using the figures of other authors without the usual credit. As an example of the latter, I may cite this use of no less than five of my figures of Jurassic mammals, in his memoir on Mesozoic Mammalia.

Prof. Osborn in his review alludes to "the extremely complex and confusing dentition" of some Mesozoic mammals, and of the truth of this statement his own papers afford many illustrations besides those here mentioned. What this perplexing subject really needs, however, is more facts and less theories. Believing this, I have endeavored to secure new facts by long and laborious explorations, hoping in this way to clear up some of the confusion which so puzzles fireside naturalists. The 1,500 specimens Mesozoic mammals I have thus secured, fragmentary though most of them are, will, I trust, prove of some service in this work, although their full investigation has been delayed by other duties.

No one who has earnest work to do can afford to spend time in the ungracious task of pointing out errors in the work of others. For this reason, I have hitherto said nothing about the mistakes in Prof. Osborn's papers on Mesozoic mammals, intending to wait until my own memoir on the subject, for which I have collected so much material, should make it my duty to review the whole subject. The injustice of his criticism on my preliminary work while in progress made a brief reply necessary. The full discussion, I must still reserve for my memoir.

New Haven, Conn., April 10th, 1891.

THE COMING MAN.

BY S. V. CLEVENGER.

SANCHO PANZA remarked that men were as God made them, and sometimes a great deal worse. But it is becoming known that the world is really improving; that a line touching the dark ages and passing through our present imperfect civilization may be produced indefinitely, in imagination, toward better things. So Sancho's horizon was cramped, and we may now believe that man in general is better than he was born.

Of course "perfection" in anything is unattainable, and discussion of the "perfect man" could only be carried to any sort of a conclusion by, first of all, recognizing that there cannot be such a creation, for the very conception involves contradictions. Herbert Spencer has ably gone over this and kindred subjects in showing that everything is relative, and that no matter what advances may be made, others are still possible. Equilibrium means death, a cessation of inter- and counter-action. "Perfection" is inconceivable, and the ignorant, who imagine they can conceive it, may be convinced that their ideal was a frightful hobgoblin after all.

Picture to yourself what the African, the American Indian, or the primitive people of any country, would regard as the perfect man, and compare their wild and, in the main, hideous conceptions with those of "civilized" men,—particularly that portion to whom thought is an effort. But as the science of comparative mythology plainly shows that deification is this same process; that gods were always big men; anthropomorphism, from which no one can completely free himself, runs rampant through our ideas of any sort of superiority, whether of this world or another, The Joves, Wodins, Thors, Brahmas were muscular and sometimes noisy, and some early races allotted many legs and arms or other parts to their gods; or, as in an Egyptian instance, conferred extraordinary length of arms, as symbolizing great power.

And in this *powerfulness* we have the general underlying agreement as to, at least, what is accomplished by "perfection."

This apparently indirect manner of approach to our subject enables us to save time by clearing up in our minds what we mean, and do not mean, when we speak of the perfect man, or his approximation, *the better man.* And still we are driven to narrower ground by recollecting that John L. Sullivan might have an opinion on this topic differing somewhat from that of Oliver Wendell Holmes and other essayists.

We are asked: "What qualities are most essential for the perfecting of a human being? What are the cardinal points to be insisted upon for the all-round development of the coming man?"

The modern scientific method of finding an answer would compel us to take another ramble over creation, for man is part of the universe, and cannot be fairly considered apart therefrom, though we may avoid unnecessary discursiveness in the endeavor.

Looking at the worst phase first, in all ages man has been a sorry sort of brute, with animal propensities, desires, passions; and, as Buckle has fully shown, his civilization has been a growth from feuds, follies, conquests, individual and tribal selfishness and rapacity; but with increase of intelligence a respect for the rights of others came about, because man recognized that he best conserved his selfish interests by mutual regard. Self-protection was assured by family protection, and both these by tribal protection, and it is dawning upon the world that national barriers must eventually give way to the universality of interests; nor is the heterogeneity of the "brotherhood of man," with diversity of aims, ideas, capabilities, and needs, any greater, comparatively, to-day, between races, than it was ages ago between many individuals of the same tribe.

Altruism is the highest egoism, and is developed from it. In plain words, as Darwin expressed it, club law instituted morality in savage tribes. This club law, and the fear of it, led to an habitual regard for the method of avoiding its enforcement, and it became folly to be other than virtuous under such circumstances.

Knight errantry, the duello, and finally, in these days, suits at

law, with occasional relapses into the older methods of adjustment, afforded object lessons in expediency which sages and patriarchs dwelt upon to the inexperienced.

The history of the world includes the evolution from lower to higher expediency ideals. Disregard for the rights of others was a means by which our savage ancestors sought to prolong life and secure enjoyment. With less of this brutality, but nevertheless with plenty of suffering abounding through his thoughtlessness and his inability to curb his passions, the barbarian is an improvement upon the savage in this matter of expediency ideals. His love of ornamentation, luxuriance, and similar childish traits cause his actions to be merely an exaggeration of what we find to-day in civilized society. "Civilized" nations are but barbarians masquerading in the apparel afforded them by a development of the arts and sciences beyond their deserts. The earrings, the bustles, the tight lacing, the artificialities generally, the worship of wealth, the indifference as to how one may have acquired money, the abandonment to pleasure procuring, sight-seeing in and avoidance of scenes of suffering and squalor, the social vanities and dissipations, prove that the masses, rich and poor alike, divested of the tinsel afforded them by the fair devotees of science and art, might as readily be Turks or Hottentots.

Vulgar expediency ideals pervade our popular novels. The getting of wealth, the capturing of beauty, the utter want of a worthy aim in life prevail, and the success of authors who pander to this taste is a measure of what the purchasers of these books appreciate.

The right does not change, but our ideas of right do. Hero worship is dying out, and principles, not men, receive more deference. The race has had to make this advance through bitter experience, constant disappointments, disillusions, the shattering of idols, the growth of knowledge. Religion, with its hopes and fears, its system of rewards and punishments, notwithstanding these were "other worldly," became stimuli to good and deterrants from evil. The bare fact that some would act consistently with belief that there was a life after death, where he would suffer pain or pleasure according to what he had done in

this world, shows that the believer was guided by expediency, but truly of a higher kind. Surely the conventional ideas of right and wrong, even in this day, make a grand mess. The biases are innumerable that are created by rank, caste, prejudice, relative degrees of ignorance and intelligence, training, education, and nationality. A single instance can be cited: the term "morganatic," which is a wink at the license of royalty. "The king can do no wrong." Princes may be debauchees, drunkards, vicious, but they are defended, and their most public outrages are denied or condoned. Even dictionaries smile complacently at the villiany of nobles by giving a definition that does not include all that is known to be the meaning of the word morganatic.

However much we may assert to the contrary, and even though upon reflection we acknowledge to ourselves that wealth and good looks should not be measures of respectability, the childish trait is universally prevalent, even among civilized adults, that the good looking man, the well-dressed man, the wealthy man, is alone the good man. Poverty is regarded as evidence of punishment for wickedness. The every act of the bulk of mankind proclaim this to be a deep-rooted belief.

But surely there is a conscience, private and public, that works for final good. Undoubtedly. But we can understand that conscience, and its peculiarities and well-known inconsistencies, if we can bring ourselves to calmly inspect its origin in the law that *the altered or acquired habits of one set of ancestors may greatly affect the conduct of their descendants.* For instance, A is a murderer and freebooter, living many centuries ago, when to be otherwise was scarcely the rule. His surroundings and associations made him such. His child, B, at a later time and under better influences, is taught a disrelish for his parents' pastimes, but could easily relapse, as the inherited instincts were strong within him.

The good influence is kept up, however, and the grandchild, C, does not murder or plunder, because he has inherited a corrected disposition, which is intensified by the circumstances under which he lives. The great grandchild, D, by persistence of these conditions, would as surely be benefited by the inheritance for good

as he was likely to resemble his progenitors in feature or form. He has a ready-made conscience, for which he is not at all responsible, and deserves no credit. It might be so acute as to cause him to die of remorse, were he betrayed into wrongdoing.

Having reached this *negative* plane of mere respectability, D and his successors may develop some *positive* good trait, the habitual practice of which may become second nature. The feudal lord of A's time found happiness only in the desolation of others; F and G, his philosophical descendants, like Sir Titus Salt, grieve if they cannot find some means of doing lasting good to humanity, and yet from A to X, Y, and Z, expediency governs all of them.

One finds it most expedient to obey the promptings of his conscience, and derives comfort only from so doing. The keeping alive of that "celestial spark" may be to him more valuable than all the possessions of the world; while another, with none of this "spark" to speak of, or who may have had it developed in some other direction, kicks the beggar who annoys him, and laughs with pleasure when he recollects the event. The philanthropist feels a heart glow in remembering how he has relieved some one in distress or has contributed to some reform movement.

Different influences for good brought to bear upon successive generations are sure to appear in the last generation in a radical change of character from that of the remote ancestor, making it as impossible for X to do an evil deed deliberately as it was for A to do anything else. So you see that expediency, the doing of that from which we expect to draw the most comfort, is the controlling spirit of action in all.

The world's history shows that people became better only through intelligence; that this made it possible for them to adopt higher expediency planes; by regard for the rights of others each found his own rights best conserved. Nor did mankind, until the habit was instituted, do right from any other motive than that of mere convenience. The highest efflorescence of this natural law, beginning with the club, will be in the appearance of a highly developed altruism in a later age. Social maladies, poverty, and unhappiness will not be allowed to exist, upon the

principle, but recently discovered, that the presence of a degraded race devolves the degradation of neighboring races.

The structure of the brain itself shows that expediency regard is intellect; the nervous system plainly rules bodily parts. In higher and still higher grades of intelligence the connecting strands of the brain, the countless tangles of telegraph lines that inter-relate these parts, are more complex and numerous; and the main distinction between the idiot and one who is mentally sound is that the latter, by the integrity of his mental mechanism, is able to better adjust his inner to his outer relations. He is more in keeping with his surroundings. So goodness is a form of wisdom, after all. Habit and conscience make it possible for us to do right for right's sake, but habit and conscience are the product of your environment and what you have inherited. Conscience causes the right thing to be automatically performed. You do instinctively, and perforce, what before required a motive, just as the engineer can manage his machine in the dark and without thought, but when he was learning to do so his every sense must be alert. This view explains the inconsistencies of our nature; morality is but intellect, and no intellect is completely symmetrical. Ideas of propriety vary within wide limits. Disease may degrade mind in one way in one patient, and in other ways in other patients, depending upon the resistive strength of inherited traits, and what has been inherited.

And this brings us to a consideration of the old saw, "*mens sana*," etc., from the anthropological or physical point of view. A superficial consideration would suggest that mind and body must be developed symmetrically to accomplish the best results, but while this may hold good for mediocrity in both, which is nature's method of averaging things, we can readily see that athletes, gymnasts, pugilists unduly nourish and train their muscles at the expense of their brains, and that book-worms and thinkers generally incline to too much passivity physically. The world has reaped advantage from its diseased and bodily imperfect Gibbon, Tom Hood, Walter Scott, Sam Johnson, and Byron, though in different measures, and from imperfect temperaments such as Bacon, Coleridge, Dean Swift, De Quincy. But we should only

consider their defects as their misfortunes, and not the cause of their literary bents, for mental deformity has among potentates been the cause of untold suffering to nations. Neither physical nor mental perfection (if we can grant that such things existed) seem to have assured lasting integrity to either body or mind. The Spartans as a race do not appear to have been the fittest to survive, and during certain epochs in European history the man who dared to think at all could with difficulty keep his head on his shoulders.

But we must not lose sight of the fact that the world has profited more by the individual labors of men and women whose intellectual greatness was coupled with such extreme modesty that, while in quiet ways their power for good was incalculable, they never cared to take credit for it. "Full many a flower," etc., as Cowper has it.

As good machinery may, other things being equal, be expected to do good work, or better than imperfect machinery, a certain amount of good health is requisite for the accomplishment of any ordinary life-work.

Then there must be suitable consideration of the fact that were society built upon the principle of the "One-Hoss Shay," the wheels could not do the work of the thills, and so on, but each part could do its perfect work only by reason of the radical perfection of differences. So we are forced to regard the "perfect man" as one who is suited to his particular place and environment; and as development is only possible to its fullest extent when environment, opportunity, and ability are favorable, we will have to suppose a case to which the following applies:

1. Excellent physical and mental heredity has barred out the chances of consumption, insanity, liquor addiction, criminality, decrepitude, or ugliness.

2. As "every child has the right to be well born," so he has the right to good training, and our typical better man can only come from better folk with the right ideas of nurture.

3. This entails having not too many in the family, for the lower the race the more prolific; and highest culture is possible only, as a rule, where time can be devoted to the rearing and instruction of a few children.

4. The parents should have the direct supervision of the child's care, for among the very wealthy and the very poor neglect of children is too often the rule, and there is nothing in the world that can take the place of parental, especially motherly, love and care.

5. Circumstances do not permit one to develop as he will, or should; and as poverty produces thoughtfulness, thrift, and sympathy, and a better understanding of our neighbors' needs and characters, he who is unfortunate enough to be born wealthy should be brought into closer contact with the "other half" of the world.

6. As accomplishing something in the world is the only measure of adaptability, the means for such accomplishment should be sought, but not at the sacrifice of conscience,—whether acquired or ready made by ancestors.

7. He should be a man of fair size, because every one is inclined to discredit the possibility of a small man doing big things. Measure up your own list of heroes. Large-sized men are for this reason apt to be overestimated, just as titled individuals are who accomplish anything. Was it Huxley who said that Argyle was very smart—for a duke?

8. The *proper* regard for his individual interests will entail a genuine altruism which will make him not only a patriot (not of the demagogue kind) but a lover of liberty for the world. Kosciusco, Kossuth, Washington, Fayette, Garibaldi actively interested themselves in universal freedom when their own countries could spare their attention.

9. He could with great advantage be an American, for in America truth is left free to combat error; and no tyranny can be enduring under such auspices.

10. His education should be with regard to Herbert Spencer's idea that, first and foremost, that knowledge should be acquired which is of most practical worth to the individual, and that the ornamental should have last consideration. Overdoses of classical verbiage and minute details of the intrigues of courtiers would thus give place to physics and chemistry, which are of more account in this work-a-day world.

11. The cultivation of self-control, in the recognition that man is his own worst enemy.

12. Other desirabilities may be subclassed under the preceding.

In a general way, and when aberrant types are excluded, the increase of the facial angle of Camper in the evolutionary scale has a value as an index to what nature does to increase intelligence. It is a very superficial physiognomical means of estimation, however, if associated matters are not properly considered at the same time, for the skull-growth may not keep pace always with brain-growth, in individuals or races, and complexity of convolutions may result to fold into smaller space the same amount of brain surface that may also be found with fewer convolutions in a larger, or more roomy, skull.

It is the multiplicity and complexity of the nerve-strands in the brain that causes intelligence, and these are developed by proper exercise and education of the senses in relation to the finer muscular movements. The learning of something to do that will benefit the world as well as self, and deep thinking thereon, and endeavoring to understand the universe, as far as possible, is best calculated to develop the brain most symmetrically, repress the evil and bring out all the good of which the highest type of man is capable, for goodness is but a high order of intelligence, notwithstanding its occasional absence in intellects otherwise highly developed, and its frequent presence among those whose minds are defective in other directions.

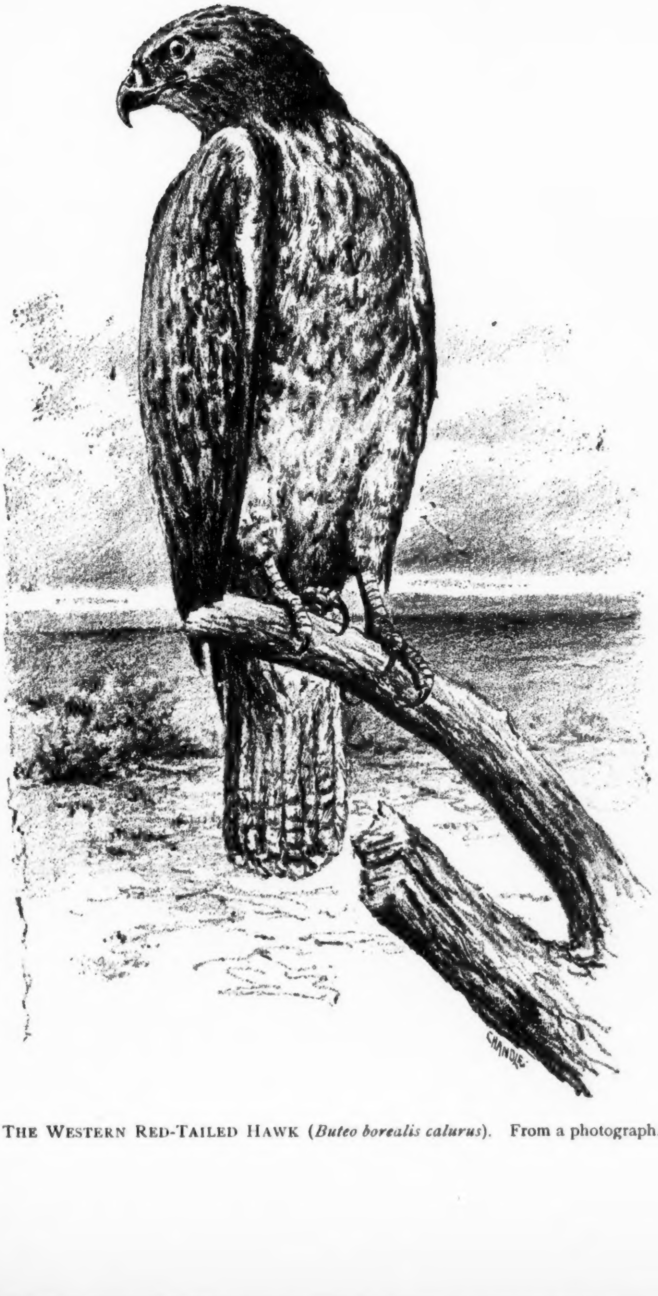
WHERE YOUNG AMATEUR PHOTOGRAPHERS CAN BE OF ASSISTANCE TO SCIENCE.

BY DR. R. W. SHUFELDT.

OF all the instruments that have come into use in the hands of science during the latter part of the present decade, none of them have been found so universally helpful as has been the camera. The photographic camera, with its modern multitudinous appliances, has made its power felt in the greatest variety of ways in all the departments of science, as in physics, chemistry, mechanics, astronomy, zoology, and each and the rest. But it is not my object to present an historical essay here upon this instrument, nor even to make the attempt to write out all I know about the operating of one in its details; it is merely my aim to bring a few practical hints before young photographers, and show them some of the new fields wherein, by patience and study, they can put their instruments to very excellent uses. As we all know, the art of photography is now easily acquired, and the producing of photographic pictures a pleasurable and sometimes a profitable employment. Yet how often it is that we see a young person purchase a first-class camera with its entire outfit, and after coming to be a good photographer, is satisfied at the end of a year or so with having filled a large album with pictures of the country around about his or her place of residence, or groups of friends, and perhaps a few other subjects, when the whole, save the album, is relegated to a corner in the garret. This is by no means a rare occurrence and the end of such enterprises.

I am a working naturalist, and a number of years ago conceived the idea that a good photographic outfit would meet a variety of ends in the course of my labors. A hundred dollars gave me one, and three times that amount of money would not induce me to part with it now. Including all my early failures, more than fifty per cent. of my pictures, and there have been a great many of them, have been published as illustrations to my scientific papers, and elsewhere.

PLATE XIII.



THE WESTERN RED-TAILED HAWK (*Buteo borealis calurus*). From a photograph.

When one comes to examine the figures of mammals, birds, reptiles, fish, and other forms that illustrate many of our older works in zoology, he can be but struck with the fact how wide of the mark the majority of them are. Indeed, it is frequently difficult to recognize the form of the animal that the artist intended to depict from the drawing he has made of it.

It was along such lines, as well as others nearly related thereto, that I hoped to introduce an improvement into my own designs. So simple are these steps that I feel sure that any painstaking young photographer can acquire and practice them, —and that, too, to profitable ends; to his personal enjoyment in the pursuit; or to the great assistance of others; or even to the advancement of learning; possibly to all of these combined.

A year or so ago I was collecting zoological and ethnological material in Northwestern New Mexico, and among many other things captured a great number of tiger salamanders (*Amblystoma tigrinum*), which were sent to biological laboratories all over the world. Now a salamander is a difficult subject to get a good figure of, and there are comparatively but few such throughout the entire range of zoological literature. This was my way of obtaining one with the camera: I fixed a small pine shelf perpendicular to the wall of my study at a convenient distance above the floor. This I covered with a large sheet of clean, white blotting paper, bending it so it hung down over the shelf in front, and likewise extended up over the wall behind. It was held in place by pinning it to the shelf with artists' thumb-tacks. Next placing any long, small object on the middle of the shelf in the place to be afterwards occupied by the salamander, we focus upon it with the camera, a strong light coming directly from behind the instrument. Insert your diaphragm with the smallest aperture, and remove the "dummy" from off the shelf. Now we are ready for the subject, and as it is very difficult to get one of these animals to lie still an instant, I waved over his nostrils, for a second or two, the fumes of a little sulphuric ether, and placed him in position on the shelf. As he recovered from the anæsthetic, he assumed a very natural attitude, and was perfectly quiet, allowing me to make an exposure of two minutes, and the

FIG. 1. — The Tiger Salamander (*A. tigrinum*); life size.

result was I obtained a good working negative.[1] The object of the blotting paper is to give a sharp figure, bereft of all surroundings, and that is one kind of picture largely demanded in zoological illustrations. Of course we *can* have all the grass, stones, and the rest of it that we want, but, as I say, that is not the kind of figure desired. The nap on the blotting paper usually gives a peculiarly soft background, and dead white in the reproduction made from the negative.

In nearly all cases such a negative should be *intensified* by the usual method with bichloride of mercury and the ammonia bath. It sharpens all the details of the figures, and makes a better print for the object in view. Now from such a negative a good photograph can be made upon sensitized albumen paper, and from this a drawing can be made. Or, any of the photo-engravers, by the various methods now employed, can make an electrotype from this negative, from which any number of figures can be printed. Yet again, you can make a print from it upon plain, non-albumenized, sensitized paper, which figure can be afterwards colored by hand from the original, and then handed to a lithographer for reproduction. Finally, one of the prints on this plain paper, can be delicately traced over by means of one of Gillott's mapping pens (No. 291) and Higgins' American drawing ink, and, when dry, the print can be submitted to a bath of saturated corrosive sublimate, and removes everything save what you have traced with your drawing ink. The "black and white" figure thus produced can be electro-

[1] Had not this negative, and the one described beyond of the Buteo, been broken just prior to having good prints made from them, they could have been used in the repro-

typed by any of the ordinary methods, at a very moderate cost, and it will make a fair figure to illustrate what the young naturalist may have to say in the journal he subscribes for,—as, for instance, the reports of any of the many chapters of the Agassiz Association to President Ballard. Excellent figures of fish may be obtained by any of the above methods, if you will but go to the trouble of constructing a glass tank of clear panes of window-glass, say 10x16, but only an inch or two apart, and parallel. In such a tank, filled with the very clearest of water, your ordinary-sized fish will be kept constantly in position and quiet. You can photograph through the double glass and the water, but you must only have the sky behind it for a background. To get an animal life-size you measure it with a pair of compasses, and compare this measurement with the image on the ground-glass of the camera, after you have finally focused to your liking. Your best stock of patience will be demanded in the photography of living birds. An entire chapter might be written upon this branch of the subject, and then it would hardly be exhausted. The same scrupulous care must be exercised in reference to position, the accessories, the backgrounds, and the rest of it. Very often we get excellent pictures from slightly wounded birds, and this was the case with the specimen of the Western Red-Tailed Hawk here offered in illustration. I made the photograph of this specimen in New Mexico in 1888.

It will be seen that I selected a rugged pine stump for him to stand upon, and this perch was sharply focused before placing my subject upon it. Further, it must be noticed that I secured a horizon; in other words, the hawk is brought out in strong relief against a good sky, which occupies the upper half of the figure. It would have been a simple matter to have placed a dead bird under one of his talons, but it was not done in this case; I have

duction of "half-tone" process figures. As it was, however, I had only secured prints fixed by hyposulphite of soda. So with the pentagraph. Mr. W. H. Chandlee, the artist of the U. S. National Museum, made the very accurate and beautiful drawings from them which illustrate this article. But even this method (in which the camera plays an equally important part) is as fully as useful, and one often resorted to by the artist who desires to obtain accurate and artistic illustrations in zoology. On this point see the author's letter to the editor in *The Auk* for April, 1891, entitled "Camera Notes for Ornithologists."

figures of owls wherein I have accomplished it. Where no background is demanded, such birds can be photographed in one's study, with a white sheet behind them, and against this cone-bearing pine boughs, old stumps, and the like, come out beautifully, and elegant figures of many kinds can be reproduced from the negative thus secured. A pneumatic snap-shutter is almost an indispensable adjunct to your camera in the proper photography of birds, as some of them have to be partially hypnotized before placed in position to be taken. Then, as they recover from the effect of this, they dress their plumage, assume a natural posture, and then appear animated. You now watch your opportunity, and secure an instantaneous picture of your feathered subject. In the forest you can often get most valuable negatives of nests and similar objects, all of which are highly prized by the scientific naturalist, and can be used in his work. Large lizards, such as our "Gila Monster" of Arizona, I have obtained by firmly strapping my camera in such a manner as to have the line of the focal axis perpendicular to the floor, upon which I have placed a sheet of white blotting paper, and then allowed the reptile to walk over it, and as he came beneath the lens, I secured a first-class negative of him. In the case of mammals, I have obtained photographs of dead ones, placed in natural postures, so faithfully done that they deceived the eyes of the best experts afterwards. My badger, published in *Forest and Stream* several years ago, was taken in that way, and very numerous other subjects, both since and before it.

The field and line of work I have briefly indicated above, is brimful of interest for the enthusiastic young naturalist, and one wherein he will soon find that all his ingenuity will be most amply demanded. As every faithful young biologist should keep his "journal" of observations made afield, and in the forest, or afloat, he will very soon find that his camera will aid him immensely in affording the means of furnishing permanent pictures wherewith to illustrate his remarks, and these in addition to the ones used from which his photo-electrotypes have been selected for printing.

PLATE XVI.

Carettochelys insculpta.

ON THE RELATIONS OF CARETTOCHELYS, RAMSAY

BY G. BAUR.

IN May, 1886, Prof. E. P. Ramsay, (1) of the Australian Museum, Sydney, described a peculiar new tortoise under the name of *Carettochelys insculptus*.[1] The description was based on an adult female (carapace, eighteen inches in a straight line), which was obtained in the Fly River, New Guinea. The new genus was referred to the family Trionychidæ, forming "a link between the river tortoise and the sea turtles." In 1887 Mr. Boulenger (2) placed this genus in a special family (Carettochelydidæ) of the Pleurodira, for the reason that the specimen was found in New Guinea, from which island only Pleurodira are known. The characters of this family were given as: "Plastral bones, nine. No epidermic scutes on the shell. Limbs paddle-shaped, with only two claws."

Prof. Gill, (3) nearly at the same time, wrote a review of Prof. Ramsay's paper, in which he reached the conclusion that the form is the type of a peculiar family, Carettochelyidæ, and that "it may quite likely prove to be a Pleurodire." Prof. Gill makes the following remarks: "But whatever may be the relations of the new genus, whether to the cryptodirous or pleurodirous tortoises, it has many quite peculiar characters. From all known forms it is apparently distinguished by the absence of scuta, the peculiar feet, and other characters. Undoubtedly, therefore, the new genus does not belong to any of the established modern families, and apparently not to any of the extinct ones named, although when more is known of Carettochelys, as well as the extinct forms, it may turn out that the Papuan animal is related to one of the families now regarded as extinct."

The family Carettochelydidæ of the Pleurodira was accepted by Mr. Lydekker (4) in the same year, and Hemichelys Lydekker, from the Lower Eocene of India, referred to it. In this

[1] In a preliminary note this form had been considered as a species of Cyclanosteus. The species must be named *insculpta*, not *insculptus*.

form we have five neuralia in contact with each other, and there was probably a small mesoplastron present, according to Lydekker. To conclude from the figure, it seems that there were eleven peripherals on each side, as in the Pleurodira, for instance. I believe, therefore, that it is more likely a Pleurodiran than a near relative of Carettochelys.

In 1890 I published a short note on Carettochelys, (5) in which I doubted the Pleurodiran nature of the genus. I said: "It is true it belongs the Papuarian region, in which, so far, only Pleurodira have been found. There are some characters, however, not seen in the Pleurodira, but in another group of Chelonians consisting of the families Cinosternidæ, Staurotypidæ, and Pseudotrionychidæ. It is only in this group that we find twenty-one peripheralia (marginal bones), as in Carettochelys; the neural bones are also reduced, and the dermal shields have disappeared entirely, as in Pseudotrionyx; to the latter character, however, I attach little value, as it may occur in any family.

"It seems to me that the systematic position of Carettochelys is far from being clear. How easily could the whole question be settled! Mr. Ramsay would do a great service to science if he would undertake to have the cervicals and the skull extracted, or the cervicals alone, if he fears for the skull. This could be done without injuring the specimen, and the structure of these parts would show at once the affinities of this peculiar genus."

Not doubting that Carettochelys would prove a very important form of the Testudinata, I wrote to Prof Ramsay, asking him if he could not examine the osteology of the animal, and publish a note about it. A short time before I received an answer I read Dr. Alexander Strauch's Bemerkungen über die Schildkrötensammlung im zoologischen Museum der kaiserlichen Akademie der Wissenschaften zu St. Pétersburg. (6)

Dr. Strauch, whose classification of the tortoises is far behind the times, and certainly not accepted by anybody—(he does not distinguish the Pleurodira from the Cryptodira, but places them in one group, Testudinida, of the same rank as the Cheloniida! The unfortunate separation of Dermochelys as a suborder Atheca is still kept up!)—places Carettochelys in a special "Abtheilũng"

of the Thecophora, with the name Carettochelyda. "Rückenschild herzförmig mit Randknochen. Brustschildknochen zu einer Platte verwachsen. Schale ohne Hornplatten Floasenfüsse mit 2 Krallen. Phalangen der Zehen mit Condylen." Strauch remarks: "Soweit sich nach der allerdings noch sehr unvollkommenen Beschreibung Ramsay's urtheilen lässt, muss seine *Carettochelys insculpta* unbedingt zum Typus einer besonderen, den Trionychiden und den Meerschildkröten gleich werthigen Familie (nach Boulenger also Superfamilie) erhoben und im System zwischen diese beiden gestellt werden."

Shortly after I had read Dr. Strauch's paper I received an answer from Prof. Ramsay, which I will give in full: "I received your note on Carettochelys in due time, but owing to the internal alterations going on in the museum the specimen could not be got at, and it is only now that I have been able to examine it. Alas! there were *no cervical* vertebræ to examine; the animal had served the explorer for food, and the whole of the bones, except the skull, had been cut away. I had this photographed for you, and hope it will help to place the very interesting form in its proper place. I shall be glad to help you in any way; but there is nothing to work on, more than I have given in the Proc. Linn. Soc. N. S. W., Vol. I., 1886, p. 158, with plates."

This was bad news. Nothing left of the bones but the skull! But probably it was possible to determine the systematic position of the interesting animal from the photographs, which were on the way. A few days after the letter the photographs came: 1, two upper views of the entire animal; 2, one lower view; 3, the upper view, and 4th, the lower view of the posterior portion of the skull. To Prof. Ramsay I have to express my best thanks for his great kindness and liberality.

The skull at once showed that this form was no Pleurodiran; that its nearest living relatives appeared to be the Trionychia, its very closest fossil relative the peculiar Pseudotrionyx Dollo, from the Eocene, which I always had suspected as such.

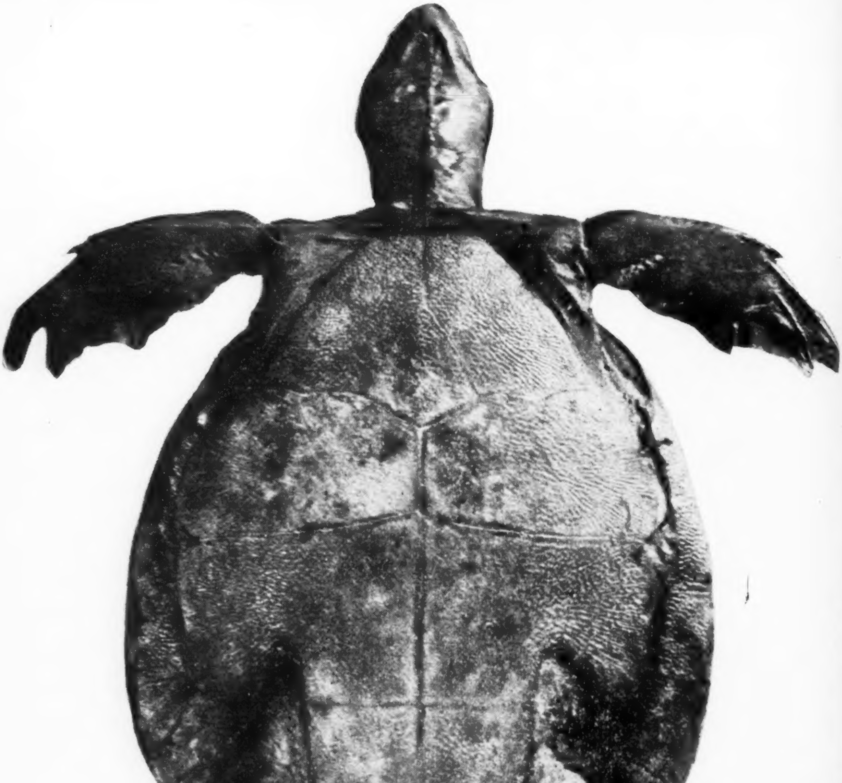
The skull is only comparable with that of the Trionychia. As in this group, we have three greatly developed, crest-like posterior processes: the supraoccipital, and on each side the squamosal. The

supraoccipital process is club-shaped and enormously developed, —more than in any other tortoise known. Of course this character alone would not be sufficient to establish absolutely the near affinity of the peculiar form with the Trionychia; such a development of the posterior portion of the skull could take place in the Pleurodira or Cryptodira just as well. But there are other characters which at once show that the form has nothing to do with the Pleurodira. Before all, the pterygoids extend behind between quadrate, basisphenoid, basioccipital, a condition never seen in the Pleurodira. Whether the pterygoids are completely separated by the basisphenoid as in the Trionychia cannot be seen from the photographs; this question, therefore, is still an open one. The quadrate is peculiar. The articular face with the lower jaw is Trionychian, not Pleurodiran; and so is the posterior end of the lower jaw. The quadrate is not completely closed behind, but only on its outer border, as in Podocnemis, for instance, but not in such a great degree. As is well known, the quadrate of the Trionychia is completely closed behind; this, of course, is a secondary condition, and there cannot be any doubt that the ancestors of the Trionychia had the quadrate open behind. The quadrate of Carettochelys is exactly of such a form which we may expect in the ancestors of the Trionychia. The pterygoids resemble very much the same elements in the Trionychia. The lower jaw is rounded in front and has a short symphysis. The upper side of the skull is very interesting. The greatest peculiarity is that the upper surface of the bones is granulated exactly as the shell. The dermal plates described by Ramsay do not exist; there are no plates on the skull at all. This peculiar condition is only found in the Jurassic *Compsemys plicatulus* Cope. The sutures of the bones of the upper side of the skull, which can be seen, just as the sutures of the elements of the carapace and plastron are visible, must have been taken as indications of dermal plates by Prof. Ramsay.

The interorbital space is very large, the orbits being completely lateral; the postorbital arch is about half of the interorbital space. The whole upper aspect of the skull reminds us of the Dermatemydidæ, Staurotypidæ, Cinosternidæ; and the arrange-

634

PLATE XV.



Carettochelys insculpta.

634 1/2

PLATE XIV.

Carettochelys insculpta.

ment of the elements is the same, the frontals being excluded from the orbits. There is no indication in the photograph of free nasal bones. The nose is projected much in front, and must have, when in fresh condition, an appearance very much like that in the Trionychia, but not so much pointed. The zygomatic arch is not elevated as in the Trionychia, but is in a line with the maxillary and quadrate, as in the Cinosternidæ, for instance.

The neck, the vertebræ of which were unfortunately not preserved, was short; but I do not see any reason why the head could not have been retracted, as in the Chelydridæ, for instance Nothing is known about the shoulder-girdle and the pelvis. But one thing seems to be sure: the pelvis was not coössified with the carapace and plastron, but free. If it had been coössified with the shell, as in the Pleurodira, it probably would have been preserved with the shell. An important question is the number of phalanges in the fourth digit; as is well known, in all Trionychia we have more than three phalanges in the fourth digit. It looks to me, as far as I can conclude from the photographs, that in Carettochelys the number three was not surpassed.

We have now to consider the carapace and plastron. Both have been figured by Ramsay, but there was some doubt about the presence or absence of a mesoplastral element. In regard to the carapace, I have nothing new to add. There is no trace of dermal scutes on the shell. The number of neurals is six; they are very slender and all separate from each other. The first six pleuralia meet in the middle line behind, being separated in front by the neuralia. The seventh and eighth neuralia touch each other completely in the middle line. There is only one postneural. The number of the peripheralia (marginal bones) is ten on each side, besides the single pygal. The most interesting new point to be noted in the plastron is the presence of a small distinct mesoplastral element. The structure of the plastron is best seen from the figure.

I have stated above that Pseudotrionyx is the nearest relative of Carettochelys. Pseudotrionyx was described by Dollo (6) in 1886. The portions found in the Middle Eocene of Belgium consisted of the posterior part of the carapace, and the nearly complete hyo-,

hypo-, and xiphiplastron of the right side. The sculpturing o the shell is the same as in Carettochelys. There is no trace of dermal scutes. The number of the peripheralia is the same as in Carettochelys. There is only one postneural, of the same shape as in this form. There is a difference in the neuralia, however. There are seven slender neuralia in Pseudotrionyx, which are all connected with each other, separating the first six pleuralia completely; the seventh pleuralia meet behind, and the eighth are entirely connected. In all the pleuralia the rib heads are well developed. If we now compare the plastron of Carettochelys with the portions preserved in Pseudotrionyx, we are struck at once by the enormous resemblance. The hyoplastra of both are nearly identical in shape. I may call especial attention to the border connecting the hyoplastron with the endo- and epiplastron. But to conclude from Dollo's figure, it seems to me that the hyoplastron was not entirely united to these elements, but only connected with them by ligament, as in the Cinosternidæ. The most interesting point, however, is that Pseudotrionyx doubtless also had a distinct mesoplastral element as Carettochelys. Dollo held the opinion that there was a small fontanelle at the outer border of the hyo- and hypoplastra (Échancrure naturelle, reste d'une fontanelle laterale, N. Fig. I., Pl. II.) Besides, he thinks that the line of the connection between carapace and plastron was very short. There cannot be any doubt, however, that Pseudotrionyx showed about the same conditions as Carettochelys.

Pseudotrionyx is placed by Dollo, Zittel, and Lydekker among the Chelydridæ. A skull originally referred by Sir R. Owen to Platemys is considered by Lydekker (8) as belonging to Pseudotrionyx. It is stated that it agrees essentially with that of Macrochelys; and that this reference is confirmed by the total absence of the impression of horny shields, indicating that the skull, as in the Trionychidæ, was merely covered with skin. I think it is at least doubtful whether this skull belongs to Pseudotrionyx.

We have now to consider the relations of Carettochelys. Its nearest relative is, as I have shown, Pseudotrionyx. There is no idenceev from the present material that Pseudotrionyx belongs to

a different family from Carettochelys. I do not hesitate, therefore, to place both genera in one family, Carettochelyidæ Boulenger, 1887, which name has the priority before Pseudotrionychidæ Boulenger, a family established in the Encyclopedia Britannica, (Vol. XXIII.), p. 457, to contain Pseudotrionyx Dollo and Anostira Leidy.

This family may be characterized in the following way:

CARETTOCHELYIDÆ.

Shell without epidermal shields. Plastron composed of eleven elements, two small mesoplastra being present, which are separated from each other. Only ten peripherals on each side, besides the single nuchal and pygal. (Carettochelys, Pseudotrionyx.)

Upper surface of skull covered with small, round, raised rugosities exactly as the shell, with three posterior processes, as in Trionychia; skull resembling in shape that of the Cinosternidæ, but snout more projecting. Limbs paddle-shaped; digits much elongate, only the two inner clawed. (Carettochelys.)

How far Pseudotrionyx agrees with Carettochelys in the latter characters, new finds have yet to determine.

The question now is, To which group of tortoises does this family belong? In a former paper I distinguished four groups of tortoises: the Amphichelydia, Cryptodira, Pleurodira, and Trionychia. Of one thing we are sure: it does not belong to the Pleurodira. Unfortunately we do not know the structure of the cervicals, which is so characteristic of the three remaining groups. From all that is at present known, it appears to me that the Carettochelyidæ are nearest to the Trionychia, but show at the same time characters of a group of Cryptodira, composed of the families Staurotypidæ and Cinosternidæ. I expressed a few years ago the opinion that the Trionychia did come from forms which had the peripherals complete, and carapace and plastron closed; that the Trionychia are not an original, but a highly specialized group. Carettochelys shows in the structure of the skull, especially of the posterior portion, Trionychian affinity. I believe that the ancestors of the Trionychia consisted of forms

which in the structure of carapace and plastron were very much like Carettochelys. On the other hand, there seem to be connections through Anostira with the groups of Cryptodira named above. These affinities are shown in the shape of the skull and plastron, and the peculiar number of peripherals. Until the cervicals and pelves are known, I think it is impossible to determine the correct systematic position of the Carettochelyidæ. The most probable view seems to be this: The Carettochelyidæ came from a group of tortoises related to the stock from which Staurotypidæ and Cinosternidæ developed. It is probable that the Carettochelyidæ are very close to the ancestors of the Trionychia, of which they are only survivals. For the ancestors of the Trionychia we have to look in the Jurassic and Lower Cretaceous; for I have shown in another paper that the Trionychia of the Upper Cretaceous (Laramie) are typical forms, in which the peripheralia had been already entirely reduced. I have little doubt that these started from the Amphichelydia.

There are some points which could be made out by examination of the unique type specimen of Carettochelys; the entire structure of the skull, for instance, the condition of the first dorsal, which is probably preserved. It would be very important to know whether the premaxillary is small and single, as in the Trionychia, or whether it is developed, as in the Staurotypidæ, for instance. It would be interesting to know whether the anterior part of the centrum of the first dorsal vertebra is modified as in the Trionychidæ or not.

I can only hope that new specimens will be collected soon in New Guinea. They doubtless exist there in great numbers, and I think the time will not be very far away when we will know the whole anatomy of this most interesting tortoise.

Clark University, Worcester, Mass., April 5th, 1891.

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EDITORIAL.

EDITORS, E. D. COPE AND J. S. KINGSLEY.

IT is generally conceded that it is important to avoid the duplication of names of like rank in the nomenclature of each of the great divisions of organic life. A genus of plants may bear the same name as a genus of animals, but no two genera of either must bear the same name. There has, however, recently developed a difference of opinion as to what constitutes identity of name. It was for a long period assumed that any difference is a difference, and that words identical except as to masculine or feminine termination are different words. Thus no one thought of regarding Picus and Pica as duplicates, and the two appeared together in ornithologies for nearly a century. But the desire for change stimulated somebody to consider the use of one of them a duplication of the other, and a new name was proposed to take the place of the one which was introduced latest. Following this example, numerous changes have been proposed for the same reason. But there are other instances where the difference extends to two letters, as in the case of Menodus and Menodon, and here also change has been introduced. If a difference of two letters is not enough to preserve two names, it becomes a question how many letters will constitute diversity, and so on. There seems to be a preference also that a difference of a letter in the beginning of a name is of greater moment than such a difference towards or at the end of a name. Thus no one has proposed to change the name Tinodon because there is also a name Dinodon, or Momus because there is a Mimus, or Mora because there is a Mola. The number of changes which may be made on such grounds as these is very great, and the name-changers have yet a large field before them.

From another point of view we can see that if differences of one or two letters are not admissible, we are debarred from the use of a large proportion of possible names. Thus we cannot have Manodus nor Monodus, nor Melodus nor Tenodus, nor

Henodus, nor Menopus, nor Menotus, on account of Menodus, and so on *ad infinitum.* The fact is, the changing of a name which differs by a single letter from another name has no warrant in any rule, or in common sense. The changing of names is an inconvenience to be avoided as far as possible, and the zeal frequently seen to make such changes without sufficient ground should be abated. When the correct spelling of a name makes it identical with another, change is necessary, since a name is only recognizable when correctly spelled. Science is nothing if not accurate.

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RECENT LITERATURE.

Catalogue of Fossil Reptilia and Batrachia (Amphibia) in the British Museum, Parts II., III., and IV.[1]—Dr. Lydekker includes in Part II. the orders Ichthyopterygia and Sauropterygia; in Part III. the Testudinata; and in Part IV. the Placodontia, Theromora, and the Batrachia (Amphibia). Part I. included the Archosaurian series (Dinosauria, Crocodilia, and Ornithosauria) and the Squamata. The order of treatment has not been a systematic one either ascending or descending, possibly for reasons connected with the administration of the museum. Apart from this, we are disposed to find fault with some features of the system adopted which are more important. Thus the streptostylicate series is quite heterogeneous, including the Rhynchocephalia, which must go with the Dinosauria in the Archosaurian line; and the Ichthyopterygia, which belong in the Synaptosaurian series. The Rynchocephalia of Lydekker, however, include some types (as Rhynchosauridæ) which, from their single coössified postorbital bar, belong in the Synaptosauria.

In the treatment of the detail of the subject embraced by these catalogues we find the conscientiousness and painstaking characteristic of the author's work generally. The definitions are comprehensible, and the treatment of material judicious so far as appears. The settlement of questions of affinity and synonymy left uncertain by the older paleontologists is a service for which students everywhere will be grateful. This was especially needed among the Testudinata, which Dr. Lydekker found in great confusion, but which he has reduced to comparative order. We have to thank him for the abolition of the name Colossochelys, which cannot be distinguished from Testudo. Some of his genera are probably too comprehensive, as, *e. g.*, Cimoliasaurus (Sauropterygia), as the author himself suggests. Trionyx also probably includes more than one genus. Here is also the place to correct some statements of the author anent the Adocidæ. He remarks (p. 129): "The so-called Adocidæ of Cope are probably also referable to the Dermatemydidæ, the abortion of the ribs not being a character of family value. In the Cretaceous genus Adocus there are traces of vermiculation, which are more distinct in the Eocene genus Agomphus, and it has yet to be proved that the latter is really distinct from the

[1] Catalogue of the Fossil Reptilia and Amphibia in the British Museum. By Richard Lydekker. Part II., 1889; Part III., 1889; Part IV., 1890. London. Published by the trustees of the British Museum.

under-mentioned genus " (Trachyaspis). The fact is, that, as I showed in 1873 (Ann. Report U. S. Geol. Surv. Terr., 1872, p. 621), Adocus has an intergular plate, and a simple contact of the inferior pelvic bones with the plastron, and is allied to Baēna, belonging therefore to Lydekker's group Amphichelydia; and the absence of rib-heads is not included in my family definitions. Also Agomphus has no trace of vermiculation, while they are strong in Trachyaspis.

We refer to some points of nomenclature which arrest our attention. The author establishes a "new family," Dermatemydidæ, and then remarks that the "so-called Adocidæ" belong to it. Should this be the case, the proper proceeding would have been to have placed Dermatemys and allies in the Adocidæ. The name Anomodontia is used instead of Theromora for the order first defined by the present critic under the latter name. Both Prof. Owen's first and last use of the former term are shown by Lydekker to have been for the division to which the later name Dicynodontia has been also applied. The latter name should be disused, both because it is a synonym and because some of its members are edentulous. Dr. Lydekker is probably correct in preferring the name Theriodonta to that of Pelycosauria, as they may refer to the same natural division, although the evidence is not all in yet. The name Cotylosauria, though proposed with an erroneous definition, is probably the proper one to apply to the subdivision Pareiosauria, while Proganosauria should be probably used in place of Procolophonia. The term Labyrinthodontia is resuscitated and used for the Stegocephali, although its original definition and etymology render it applicable to a limited subdivision only, whose actual boundaries are not yet known. In the division of the Stegocephali into orders or suborders considerable difference of opinion has developed. The obvious and simple division into Ganocephali, Rhachitomi, Embolomeri, and Microsauri is objected to by Lydekker, Zittel, and Fritsch, on grounds which seem to the present critic insufficient; and the classifications which it is proposed to substitute appear to stand on unsecure foundations. The value of the presence of complete intercentra in the cervical and dorsal regions in Embolomeri is said to be destroyed by the fact that Archegosaurus (Ganocephali) possesses the character in the *caudal* region; very inconsequent reasoning, it appears to us. Objection to the systematic importance of the segmented or rhachitomous structure is based on the fact that it is present in young Labyrinthodons, etc. This is certainly a new reason for discarding a character from systematic biology. When a character is shown to be inconstant in adults it should be relegated to the rear, but not before. That this may prove to be the case with the rhachitomous vertebra may

yet be discovered, but it has not been as yet; and it will not be soon observed with the embolomerous structure.

The author's adhesion to the law of priority in specific and generic names contributes much to the simplification of nomenclature. He is not as strict in the matter of family names. We cannot agree with him in changing a name as preoccupied, so long as it differs from the supposed preoccupier by one letter. This is not preoccupation.—C.

A. S. Woodward's Fossil Fishes.[2]—The fine collection of fossil fishes contained in the British Museum has been at last utilized as the basis of a systematic work. No better appointment could have been made for the accomplishment of this purpose than Mr. A. Smith Woodward, whose abilities as a systematic zoologist have been amply tested in this difficult field. The first part of the catalogue is devoted to the Elasmobranchii. Two hundred and ninety-six species are contained in the museum collection, which is only a part of those actually known. The value of the work is greatly enhanced by the reference list of all described species given under the head of each genus. Of the above species, twenty-four are included under the Ichthyotomi, of which fourteen are Pleuracanthidæ, and the remainder Cladodontidæ. The systematic position of the latter family is for the first time thus indicated. The doubts expressed as to the segmentation of the skull of Didymodus, expressed in this place by Mr. Woodward, have been since set at rest by an inspection of the specimens themselves, as he acknowledges in his report on American collections published in the *Geological Magazine* at a later date.

In the second part of the work Mr. Woodward takes in hand the question of the systematic relations of the fishes in general. He discards the division Ganoidei as unavailable, and adopts the subclasses Elasmobranchii, Holocephali, Dipnoi, and Teleostomi, as has been done in this country. He does not adopt the Agnatha, but accepts the superorder Ostracodermi[3] Cope, which, according to some authors, represents the former in the Paleozoic formations, and places them as a fifth subclass of the Pisces. This is a great advance over previous views held in Europe, and it now remains to be seen whether the opinion that the Ostracophori are outside the class of fishes is to be sustained by further discovery or not.

[2] Catalogue of Fossil Fishes in the British Museum. By Arthur Smith Woodward. Part I., 1889; Part II., 1891. Published by the trustees of the British Museum.

[3] This name was used by Gill in 1861 for the Scleroderm Plectognath fishes. I regret the apparent necessity for changing it, and propose the term Ostracophori to take its place.

Another important point is the definite location of the Acanthodii as a third order of the Elasmobranchii, for what appear to be entirely valid reasons. These are quite sustained by the results of a study of several species of Acanthodes, published in 1890 by Dr. Otto Reis, in a paper which had not probably come into Dr. Woodward's hands in time for notice.[4] The next important systematic step is the location of what is left of the old Placodermi after the abstraction of the Ostracophori, represented by the Coccosteidæ. These Dr. Woodward regards as Dipnoi, and the view is a plausible one. Doubtless paleontologists have no better place for them, and new evidence is likely to confirm the proposition. He names the order the Arthrodira.

Two orders of Teleostomi are adopted, the Crossopterygia and Actinopterygia; the Rhipidopterygia and Podopterygia being rejected. We have given reasons in the NATURALIST for April why we think these orders (or better, superorders) should be retained. Under Crossopterygia, four suborders are recognized,—viz., Haplistia (Tarrasiidæ); Rhipidistia (Holoptychiidæ, Rhizodontidæ, Osteolepididæ, and Onycodontidæ); Actinistia (Cœlacanthidæ); and Cladistia (Polypteridæ). The Actinopterygia are divided into two sections, A and B, corresponding to our Podopterygia and Actinopterygia respectively. The present work enters only the former division, which includes the families Palæoniscidæ, Platysomatidæ, Catopteridæ, Chondrosteidæ, Belonorhynchidæ, Acipenseridæ, and Polyodontidæ. The volume concludes with the Platysomidæ.

Many important points in the structures of these fishes are discussed, and the species which are included are placed on a permanent basis. The work is illustrated by numerous good lithographs.—C.

Mrs. Bodington on Evolution.[5]—This book, of two and a quarter hundred pages, is a popular presentation of many of the facts discovered by the more modern laborers in several fields of biology. Its nine chapters treat of the following subjects: The evolution of the eye; extinct and surviving mammalia; the flora of the past; interesting facts in evolution; microörganisms as parasites; puzzles in paleontology; the air-bladders of fishes; Neo-Lamarckism; the origin of the fittest. The authoress' presentation of these topics is both graphic and scientific, and is well calculated to interest the gen-

[4] Zurkentniss des Skelets der Acanthodinen, von Dr. Otto M. Reis; Geogn. Jahreshefte des Kgl. bayer. Oberbergamts, 1890.

[5] Studies in Evolution and Biology. By Alice Bodington. London: Elliott Stock, 8vo, 1890.

eral reader. In fact, the work is an excellent one to put into the hands of any person without scientific knowledge, who desires to get an insight into questions that occupy at present the scientific mind. An especial interest will attach to the book, in the minds of Americans, because many of the facts and conclusions described are derived from the work of their countrymen. This will be a recommendation to those foreign readers who do not desire the labor of searching the original sources in our scientific literature, for popularizers of American biologic work have not yet grown up on our own soil. The authoress is the wife of an English physician who lived at Vancouver, British Columbia, and is still a resident of that beautiful region.

Mrs. Bodington has become a Neo-Lamarckian in her views after an impartial examination of the evidence offered by paleontology, and she says: "Neo-Lamarckism supplies the 'motif' which runs through almost every study in this little book. I had not met with the works of Lamarck when these studies were written, yet it seems to me that every advance in the physical sciences which I have endeavored to chronicle adds a fresh laurel to the fame of this most unjustly decried genius. If we, who love and honor the name of Darwin, look upon him as the Newton of evolution, we surely shall not detract from his fame if we look upon Lamarck as its Galileo."

General Notes.

GEOGRAPHY AND TRAVEL.

The Peary Exploring Expeditions for Greenland and the Survey of Unexplored Regions of the Arctic Circle.—An expedition that promises to the promoters and to science generally discoveries and result of interesting import now takes the name of the North Greenland Exploring Expedition. It has been fitted out by an experienced investigator, Lieutenant Robert E. Peary, who is a civil engineer, serving in the navy with the rank of lieutenant, and for the past two years stationed at the League Island Navy Yard, Philadelphia. He has obtained a long leave of absence in order to command this enterprise, which he has personally projected and arranged, contributing largely to the necessary expenses. His former experience in the far north fit him thoroughly for his work. Five years ago he penetrated far into Greenland with a companion, and obtained a knowledge that is the basis of his present project of reaching and exploring the most northeasterly promontory of Greenland, and, if the conjectures of the existence of a polar open sea be well founded, to secure all the information obtainable about that ocean.

Among the first to see the promise of Lieutenant Peary's project were the members of the Philadelphia Academy of Natural Sciences. This institution not only extended sympathy and support, but organized a special auxiliary corps, with this personnel: Professor Angelo Heilprin, Curator-in-Charge of the Academy, will be the geologist and leader of the party; Professor Benjamin Sharp, M.D., Ph.D., also of the Academy, will be the zoologist; Professor J. F. Holt, Professor of Natural History at the Philadelphia High School, also zoologist; Dr. William T. Hughes, ornithologist; Mr. Frazer Ashhurst; Dr. Robert M. Keely, assistant ophthalmologist at the Jefferson Medical College, Philadelphia, surgeon; Dr. William H. Burk, botanist; Levi W. Mengel, Ph.G., of Reading, Pa., entomologist; and Alexander C. Kenealy, journalist.

For the voyage a diminutive but staunch steam yacht, called the "Kite," has been secured. She was built expressly for sealing trips, and has buffeted the ice-floes of Norway for nearly eighteen years, and although perfectly sound, has been strengthened and put in order

for the proposed heavy work, and supplied with every means that experience can suggest to fit her for the work.

The dimensions of the "Kite" are 117.6 feet long over all, 26.4 feet beam, and 14 feet hold. Her tonnage is 280 gross and 190 net. The engine is a vertical one of fifty-horse power, placed well aft, so as to give the propeller a short crank shaft, and thus lessen any liability to breakage. The propeller can be triced up and the rudder unshipped in thick ice. Her speed is from seven and one-half to nine knots. Her bow and sides are well protected with heavy pieces of iron and dovetailed blocks of wood.

The vessel will be commanded by Captain Richard Pike, who went with Lieutenant Greely in 1881, and was also one of the Greely rescue party in 1883. His crew will consist of chief mate, Edward Tracy; boatswain, Patrick Dunphy; chief engineer, William Jardine; second engineer, Alexander McKinley; steward, Lawrence Hackett; assistant steward, Patrick Welsh; cook, Thomas Pepper; firemen, Andrew Roost, Edward Crook, and John Cunningham, and able seamen, Thomas Collins, John Cummings, Timothy Looney, and John Verge. McKinley is from Glasgow, and Pepper from London. The others are Newfoundland seal fishermen.

Lieutenant Peary will be accompanied by his wife and five hardy seamen who have experienced the rigor of polar winter weather, and they are to stick to him in all his operations and movements. So the entire ship's company will consist of thirty persons. There will also be four large Newfoundland dogs on board.

The "Kite" sailed from New York, in June last, direct to Ivigtut, a coaling station at the southernmost point of Greenland, just back of Cape Farewell. From thence the "Kite" will proceed to Upernavik, on the northwestern coast, in latitude 73°. This is the northernmost Danish settlement of Greenland. From Upernavik the "Kite" will break her way through the ice across Melville Bay, around Cape York to Whale Sound, where Lieutenant Peary, his party, and all their supplies will be landed.

It is expected that it will take a month to reach Whale Sound, where a house will be built for Lieutenant Peary and his wife, who will accompany him on his long journey. At this point the North Greenland and the West Greenland parties will separate. The North Greenland expedition will start out and establish provision stations to the northward and eastward. About a year will be consumed in making these preparations, and it is not expected that the actual business of that part of the expedition will be begun until the

summer of 1892. Lieutenant Peary will then take a northeast route, skirting the coast, but keeping on the unbroken inland ice. As the party proceeds, their route will bend to the northward and reach the furthest point north of the Greely expedition. From that point an effort will be made to reach the northern terminus of the land and determine its character, and also the existence of an open polar sea. At the same time the Academy of Sciences corps will proceed southward. Lieutenant Peary states that he will make journeys from station to station on snow-shoes and ice-skates or skias, while provisions will be transported by Eskimo dogs and by members of the party. It is believed by Professor Heilprin and others that the party will reach within 350 miles of the North Pole by traveling, it is estimated, about 1,200 miles to and from the main station. This journey will consume about three months, including rests, and the daily journey will cover from eighteen to twenty miles. He proposes to see if the region of the North Pole is of land or water, and hopes to discover the polar open sea.

GEOLOGY AND PALEONTOLOGY.

The Name Huronian.—Professor Alexander Winchell, in the Bulletin of the Geological Society of America, Vol. II., pp. 85–124, remarks as follows:

"Clearly, the interests of geology and of truth demand an adjustment of these conflicting conditions in terminology. If Sir William Logan unwittingly extended the term Huronian over two systems now known to be distinct, that usage cannot be continued. Either the name must be restricted to the upper system, or it must be relegated to synonymy. We think it may be appropriately attached to the upper system. The early Canadian geologists sought a term which would cover, first and chiefly, the great quartzites which were found to follow the Silurian strata in downward succession. Underneath were seen so-called chloritic schists and a slate conglomerate. In the region first studied these were seen to rest on crystalline rocks, and appeared to fill completely the gap between the Silurian and the gneisses. These strata were all conformable, and evidently constituted a system. If it had not been previously named, the Canadian geologists conferred a service on science in giving it a designation.

"Soon, however, older schists than these were described; but since their structural discordance with these was not striking in the original

region, as known thirty years ago, and since their conglomerate and slaty characters were similar to those in some strata of the system first named, it was natural, or at least it was venial, to include these latter with the former. If, now, we have learned that they are geologically incongruous with the higher, it appears obviously necessary to drop them off, however prolonged the period in which they have been associated together.

"This is the view which we have maintained for several years. We have insisted that the so-called Huronian of Lake Superior is an older system than the Huronian of Lake Huron. But we were not aware, it must be confessed, until our recent studies, that the same older system was actually present north of Lake Huron.

"If, then, we restrict the term Huronian to the upper system, it remains attached to the best-known and characteristic portion of the old complex Huronian. There will remain the older system, not distinctively named until Dr. Lawson in 1866 bestowed upon it the name 'Kewatian.' In volume, in petrographic and stratigraphic characters' it is a system. It should therefore receive a name of systemic form. Such name is Kewatian, homophonous with Huronian, Silurian, and the remaining systemic names.

"Whether the term Huronian must not yield to the priority of Taconic or Cambrian, we will not discuss. Whether Kewatian can take precedence over Azoic, Taconic, and Cambrian, remains to be decided. It is the misfortune of all these names, except Kewatian, that they were originally intended to cover a complex of strata which has been proved to constitute two distinct systems."

Pre-Paleozoic Surface of the Archean Terranes of Canada.—Mr. A. C. Lawson has collected evidence to show that the hummocky aspect of the Archean terranes of North America is not due to the action of the ice of the Glacial epoch, but that it was characteristic of the surface upon which the earliest Paleozoic sediments were deposited. In pursuing the work incident to this paper, Mr. Lawson found also excellent presumptive evidence that the greater part, if not the whole, of the Canadian Archean terranes were at one time covered by Paleozoic strata. (Bull. Geol. Soc. Am., Vol. I., pp. 113–174.)

A Mesozoic Fish Fauna in New South Wales.[1]—Mr. A. Smith Woodward has recently published a memoir on some fossil fishes

[1] The Fossil Fishes of the Hawkesburg Series at Gosford. By A. Smith Woodward, F.Z.S., F.G.S. Memoirs of the Geological Survey of New South Wales. Paleontology, No. 4.

collected by Mr. Charles Cullen at Gosford, New South Wales. The series comprises nearly four hundred specimens obtained from a layer of dark-gray shale, four feet thick, interstratified with the massive beds of sandstone belonging to the Hawkesbury formation. As a result of Mr. Woodward's researches, they have been classified as follows: One Dipnoan, possibly allied to Ceratodus, *Gosfordia truncata*. Of the family Palæoniscidæ, *Myriolepis clarkei*, *M. latus*, *Apateolepis australis*; of Catopteridæ, *Dictyopyge symmetricus*, *D. illustrans*, *D. robustus*; of Belonorhynchidæ, *Belonorhynchus gigas*, *B. gracilis*; of Semionotidæ, *Semionotus australis*, *S. tenuis*, *Pristisomus gracilis*, *P. latus*, *P. crassus*, *Cleithrolepis granulatus*, *C. ? altus*; of Pholidoporidæ, *Pholidophorus gregarius*, *? Peltopleurus dubius*. All the species are new except *M. clarkei* and *C. granulatus*. Of the genera, Gosfordia, Apateolepis, and Pristisomus are new.

An examination of this list at once demonstrates that the fauna is of early Mesozoic age, and Mr. Woodward regards the Hawkesbury beds as homotaxial with the Keuper of Europe, or, at the latest, with the Rhætic. An important fact leading to this conclusion is the absence in this series of fishes with well-developed vertebral centra.

Ten plates accompany the text, from which one learns how much good work can be done with very fragmentary fossils.

A Cimoliosaurus from the Niobrara Cretaceous of Kansas.—Prof. Williston has recently described a Cimioliosaurus from the chalk of Western Kansas, which is of interest by reason of the nature and preservation of the remains. The specimen comprises the skull and twenty-eight cervical vertebræ, all attached, and with their relative positions but little disturbed. The entire length of the skull is about nineteen inches, its greatest height about nine inches. It is evident thas the skull was a long and narrow one, quite similar to that of *Plesiosaurus conybeari* Sollas. Prof. Williston describes for the first time the teeth of an American species.

Plistocene Subsidence versus Glacial Dams.—Prof. J. W. Spencer's studies of the old shore-lines, such as beaches, terraces, and sea-cliffs, in the northeastern part of North America, lead him to think that these shores were constructed at sea-level, and not moulded in glacial lakes. Under these conditions it is necessary to accept a great subsidence of the continent, in later Plistocene times, to nearly 2,700 feet in Western Pennsylvania. He also cites foreign examples to show that these continental movements are not peculiar to America, but that the record of subsidence may be read in the Barbadoes, in Asia, and in Europe. (Bull. Geol. Surv. Am., Vol. II., pp. 465–476, pl. 19.)

On Some New Fishes from South Dakota.—The Rev. D. S. McCaslin and the Rev. Wm. M. Blackburn have sent me some specimens of fossil fishes obtained by the latter gentleman from the Ree Hills in South Dakota. They are preserved on slabs of a soft, chalky rock, and are in pretty good preservation. The age of the horizon has not yet been determined. It is overlaid, according to Mr. Blackburn, by a thin layer of glacial drift. There are five species, all new to science. I describe them below, and reserve reflections as to their probable geologic age until their characters have been pointed out.

GEPHYRURA CONCENTRICA, gen. et sp. nov. Isospondylorum vel Haplomorum.—*Char. gen.*—Mouth small, the superior border formed by the premaxillary, the maxillary apparently not contributing; no teeth. Branchiostegal rays six, or probably seven. Dorsal fin median in position, short, originating above a point just posterior to the origin of the ventrals, and extending to a point above the anal fin. Vertebræ keeled, the last not modified by the development of hypural bones, but terminating abruptly, or gephyrocercal (Ryder). Caudal fin normal, and not elongate. Scales cycloid, with strong concentric grooves, and a few proximal radii crossing them. No lateral line discernible. Fins without conspicuous spines.

Char. specif.—The only specimen is broken vertically across the middle, and the posterior half shifted so as to lie immediately below its proper position. It appears that little or no part of the fish has been lost. Radii, P. 9; D. 9; C. 6–16–8; A. II 11. V. 1–6; vertebræ, 10–18. Scales in twelve longitudinal rows between dorsal and ventral fins, and equal in number to the vertebræ on the longitudinal line, or twenty-eight. Head covered with scales; five in a vertical line on the operculum. The dorsal, pectoral, and ventral fins are rather small. The caudal fin is probably not much forked, if at all. The orbit is large, but its outlines are not well preserved. The head enters the total length four and a quarter times to the base of the caudal fin-rays, and slightly exceeds the depth at the ventral fins. Total length, 61 mm.; do. of head, 15 mm.; do. to base of ventral fin, 24.5 mm.; do. to base of anal fin, 30 mm.; depth at ventrals, 14 mm.; depth at caudal peduncle, 6 mm.

This fish may belong to the Cyprinodontidæ. It is peculiar in the absence of the hypural bones, the caudal region resembling the type modified from the diphycercal, called by Ryder the gephyrocercal.

? SARDINIUS BLACKBURNII, sp. nov.—This fish is represented by a single specimen, which is in good preservation with the important ex-

ception that it lacks the head. Its generic position is therefore not positively determinable, although it is strongly suggested by the parts preserved. If not strictly a species of Sardinius, it is an allied form. The vertebræ have longitudinal fossæ; the hypural bones are well developed, and distinct from each other. The dorsal fin commences above the ventrals, and is of moderate length; anal not elongate. The spaces between the caudal hæmal spines are traversed by a slender rod obliquely downwards and backwards near the vertebræ. The scales are cycloid and with strong concentric grooves. Owing to the loss of many of the scales, the presence of a lateral line cannot be affirmed. One interneural in front of D. I.

Char. specif.—Radii, D. 1–7 (possibly one lost at the end); A. 8; V. crowded together, but not less than six. Caudal vertebræ, 17. Depth at D. I entering length to bases of caudal rays, 1.5 times. Depth of caudal peduncle, 2.25 in the same. Length from front of base of D. to end of caudal fin, 29 mm. Length of caudal vertebral series, 20 mm. Vertical depth of caudal fin, 22 mm. Length of base of dorsal fin, 6 mm.; elevation of do. 8 mm.

PROBALLOSTOMUS LONGULUS, gen. et. sp. nov.—? Isospondylorum. *Char. gen.*—Mouth small, ? superior, at the extremity of a prolonged muzzle. Dorsal vertebræ elongate, fossate; caudal vertebræ shorter. Pectoral fin median, lateral; dorsal above ventrals, median; anal small; caudal large, little emarginate. No conspicuous spines. Hypural bones distinct from each other. It is probable that the single species known is either scaleless or that the scales are extremely minute. The affinities of this genus are not exactly determinable, owing to the injured condition of the head. It may be allied to either of the two genera already enumerated. The remarkable production of the muzzle distinguishes it from either, as well as the elongate vertebræ, and corresponding width of the intercostal spaces.

Char. specif.—Radii, D. I 8; C. 6 21, 3; A. I 6; V. 10; P. 10. There is a break behind the skull, so that the number of dorsal vertebræ is uncertain; there were at least 13; caudal vertebræ, 18. The form of the postcranial regions is slender, the depth at the dorsal fin entering that region to the base of the caudal fin six times, and the total length ten times. The head enters the total minus the caudal rays, one and three-fifths times, or twice, including the caudal fin. The caudal peduncle is long, and its depth enters the total length minus the caudal fin, thirteen times; its length enters the total minus the head, two and one-half times. Total length, 87 mm.; approximate length of head, 29 mm.; of caudal vertebræ, 20 mm. Depth at ventral fins, 7 mm. Elevation of dorsal fin, 7 mm.

OLIGOPLARCHUS SQUAMIPINNIS, gen. et. sp. nov. Percidarum.—Apparently allied to Lepomis, but I cannot determine the presence of vomerine teeth or the number of the branchiostegal rays.

Char. gen.—Jaws with a few rows of conic acute teeth. Apparently no palatine or pterygoid teeth. Operculum without notch or production of the posterior angle or border. Bones of the head smooth, and not serrate. Scales ctenoid, with rough area externally and concentric grooves internally, and radii proximally. Spinous radii, D. X.; A. III.; P. I. Spinous dorsal continuous with soft portion, both together much larger than the anal fin. Caudal fin furcate. Skull with a median crest, from which a series of interneural bones extends to those supporting the dorsal fin. Lateral line not discoverable.

This genus appears to be allied to the Percid genera related to Centrarchus, which now inhabit North American waters. It differs from all of them in one way or another, as for instance in the form of the opercular border, or in the number of the spinous rays and their proportions. It is perhaps most closely allied to the extinct genus Plioplarchus Cope, differing mainly in the small number of anal rays; that genus possessing from five to seven. These differences are the same as those that separate some of the recent genera, showing that the same diversities existed in Cenozoic times as now. In the best preserved specimen I count six branchiostegal rays, but I am not sure that this is the entire number. The pubes are connected with the clavicles directly; vertebræ with lateral fossæ.

Char. specif.—This species is the most abundant, as many as twelve individuals having come under my observation. The largest is about equal in size to our smaller existing sunfish, *Lepomis pallidus*. Radii, D. X 9–10; C. 5, 17, 5; A. III 7–8; V 1–5; P. I 12. The dorsal spines increase regularly in length to the tenth; the first rises above the base of the ventral fin, which is a little behind the base of the pectoral. The anal fin commences below the first soft ray of the dorsal fin, and is nearly coterminal with the last soft ray of the same. The ventral spine is quite as robust as any of the dorsal spines, and is subquadrangular, with the external and posterior faces convex, and the anterior grooved. The anal spines are robust, the third the longest. The scales are in from twelve to fourteen longitudinal rows. In one specimen, of larger size than the others, there are seventeen rows. This probably indicates another species, but it is too imperfect for characterization. Scales rather smaller than those of the body extend on the interspinous membranes of the soft dorsal and caudal fins, and on the opercular and suborbital regions of the head. Vertebræ, D. 12, C.

16. Length, exclusive of caudal fin, 52 mm.; length of head, 18 mm.; do. to base of D. 1 (axial), 21 mm.; do. to base of ventral, 22 mm.; do. to base of anal, 35 mm.; depth at base of D. 1, 19 mm.; do. of caudal peduncle, 10 mm.; length of tenth dorsal spine, 8 mm. The specimen measured is one of the smaller ones, and is selected on account of its good condition. The larger specimen above mentioned measures 34 mm. in depth at the first dorsal spine, and the head is 28 mm. in length.

MIOPLOSUS MULTIDENTATUS, sp. nov.—Represented by a specimen nearly perfect, but wanting the caudal and anal fins. It conforms exactly to the characters of Mioplosus Cope in the distinct dorsal fins, the serrate inferior border of the preoperculum, the two anal rays, and the ctenoid scales. Radii: Br. VI (? +); D. XII–12; V. 6, no well-developed spine. Dorsal fins slightly separated at the base; the longest spinous ray the third; the first very short. Vertebræ, D. 14, C. 16, the last one counted possibly not the last, as its distal end is broken off. Scales in about twenty longitudinal rows at the ventral fins, and twelve at the caudal peduncle; with proximal radii coarse, and no concentric grooves. Posterior limb of preoperculum smooth; the inferior with nine robust teeth directed forwards. A serrated crest on the posterior part of the skull, which is either the superior branch of the posttemporal or immediately adjoins it. Eye large; muzzle short, not longer than diameter of orbit. Mouth opening obliquely upwards. Ventral fin originating a little in front of dorsal, its rays quite long. Anal originating below anterior ray of second dorsal. Depth of body at first dorsal a little less than one-third of length without caudal fins, and equal to length of head. Length of head, 35 mm.; do. to base of first dorsal, 41 mm.; do. to base of second dorsal, 75 mm. Length of muzzle to orbit, 11 mm.; depth of second dorsal, 23 mm. The proportions of this species are about as in the *M. abbreviatus*, and the number of scales as in *M labracoides*. The peculiarity consists in the increased number of spines of the first dorsal fin (nine in the other species), and dorsal vertebræ (ten in other species), and preopercular teeth (five in other species).

GEOLOGICAL POSITION.—The first observation to be made on the species above described is that they differ as to species, and three of them as to genus, from all others discovered elsewhere, both fossil and recent. The next conclusion is that they include no Cretaceous types, the only identification with a Cretaceous genus (Sardinius) being purely provisional. The third point is that the genus Mioplosus has been found hitherto in the Green River Eocene only. The age is

Cenozoic, but to which system the fauna belongs it is difficult to discover. None of the genera have been found in the Amyzon shales, and but one in the Green River shales, so that their pertinence to the Eocene fauna is doubtful. The chalky matrix much resembles that of some localities of the White River Neocene (Oligocene), and I should not be surprised if it should be found that this is the age of the fossils. It is likely that they were lacustrine in habitat.—E. D. COPE.

Geological News.—Paleozoic.—G. M. Dawson calls attention to the great Cambrian formation of the Selkirk Range. Its estimated thickness is about 40,000 feet. (Bull. Geo. Soc. Am., Vol. II., pp. 165–176.)——Mr. H. M. Ami has found a fauna in the Quebec city rocks which is distinct from that of Point Levis. If his determination of the fauna is correct, the horizon of these rocks is that of the Trenton. (Bull. Geol. Soc. Am., Vol. II., pp. 477–502.)——Mr. J. L. James considers the Maquoketa shales an extension of the Cincinnati group. He bases this opinion on studies of rocks of the Cincinnati age from Richmond, Indiana, to Savannah, Illinois. (*Am. Geol.*, June, 1890.)——H. R. Geiger and Arthur Keith classify the sandstones of the Blue Ridge near Harper's Ferry as Upper Silurian. (Bull. Geol. Soc. Am., Vol. II., pp. 155–164, pls. 4, 5.)——Mr. J. F. Whiteaves has recently described and figured several new species of fossils from the Devonian rocks of Manitoba. The list comprises one Brachiopod, three Mollusks, two Gasteropods, and nine Cephalopods. (Trans. Roy. Soc. Can., Sect. IV., 1890.)——Mr. S. A. Miller reports forty new species of Crinoids from the Lower Carboniferous of Missouri. More than half of the number belong to the genus Platycrimus. (Bull. No. 4, Mo. Geol. Surv.)

Mesozoic.—Mr. A. Smith Woodward has added the following new species to the list of British Jurassic fishes: *Eurycormus grandis*, *Hypsocormus leedsi*, *H. tenuirostris*, *Leedsichtlys problematicus*, *Browneichthys ornatus*. (*Geol. Mag.*, Oct., 1889.)

Cenozoic.—During the past season Mr. G. F. Becker has found additional reasons for maintaining the existence of diabase in the Washoe Cenozoic rocks, and also for dividing the pyroxene andesite into two distinct outflows, separated by a long interval of time. (Bull. No. 6, Cal. Acad. Science.)——Mr. N. H. Darton, of the U. S. Geol. Surv., names the Eocene formation which extends through Maryland and Virginia the Pamunky, and the Miocene of the same region the Chesapeake. (Bull. Geol. Soc. Am., Vol. II,, pp. 431–450, pl. 16.

MINERALOGY AND PETROGRAPHY.[1]

New Minerals.—*Aguilarite.*—A new regular mineral from Guanajuato, Mexico, has been named by Genth[2] *aguilarite.* It is imbedded in colorless calcite as brilliant iron-black skeleton dodecahedrons, elongated in the direction of one of the crystallographic or one of the octahedral axes. The mineral is sectile. It possesses no cleavage, has a hardness of 2.5 and density of 7.586. Its composition (Ag = 79.07; S = 5.86; Se = 14.82) corresponds to Ag_2S+Ag_2Se. Upon alteration it yields a scaly iron-black substance, with the composition of cupriferous stephanite, and metallic silver.——*Griphite.*—In the granite at the Riverton Lode, near Harney City, South Dakota, occur kidney-shaped masses of a phosphate, dark brown in reflected light, and yellowish-brown or brown in transmitted light. It is amorphous, and has no cleavage. Its density is 3.401, and its hardness 5.5. It is easily fusible in the flame of a candle, and is soluble in acids. Its composition, as found by Mr. Headdon,[3] is:

P_2O_5	MnO	CaO	Al_2O_3	FeO	MgO	Na_2O	K_2O	Li_2O	H_2O	Ce	F	Ues
38.52	29.64	7.47	10.13	4.00	.15	5.52	.30	tr.	4.29	.11	tr.	.16

On account of its composition, which cannot be represented by a simple formula, the author calls the substance *griphite*, from γριφος, a puzzle.——*Kaliborite*[4] is associated with pinnoite and boracite in the upper layers of the Kainite zone at Stassfurt, Germany. It is a white, granular substance with a density of 2.05. It is slightly soluble in water, and dissolves easily in dilute acids. Its composition is:

$$\begin{matrix} B_2O_3 & MgO & K_2O & H_2O \\ 57.46 & 12.06 & 6.48 & 24.00 \end{matrix} = K_4Mg_9B_{48}O_{83}+39H_2O.$$

——The new mineral *falkenhaynite*, described by Scharizer[5] from Joachimsthal, Bohemia, is regarded by Sandberger[6] as a member of the bournonite group, differing from annivite in containing more antimony and less arsenic than this latter, and almost no bismuth. Its composition, as found by Scharizer, is:

S	Sl	As	Bi	Cu	Fe	Qu
25.76	24.30	5.02	.34	39.77	2.83	1.99

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] *Amer. Jour. Sci.*, May, 1891, p. 401.

[3] *Amer. Jour. Sci.*, May, 1891, p. 415.

[4] Chemkier Zeits., 1889, p. 1188. Ref. *N. J. B. f. Min.*, etc., 1889, I., p. 237.

[5] Jahrb. I. K. K. Geol. Rich., 1890, p. 433.

[6] *Neues Jahrb. f. Min.*, etc., 1891, I., p. 274.

The mineral is steel-gray, with a grayish-black streak.——*Sanguinite*[7] is associated with argentite and proustite at Chañarcillo, Mexico, as bronze-red scales, containing sulphur, arsenic, and silver. By reflected light the scales are black; by transmitted light they are red. The streak is dark purplish-red. Crystallization probably hexagonal. The material available was too scanty to allow of analysis.——*Kallicite*, from Grube Friedrich, near Schöristein, on the river Sieg, in Prussia, is a nickel sulph-antimonide of composition, according to Laspeyres,[8] as follows:

S	Sl	As	Bi	Fe	Co	Nic
14.391	44.942	2.016	11.758	276	.889	26.943

equivalent to NiAsS+2NiBiS+13NiS6S. Its specific gravity is 7.011, and its position in the systematic classification of minerals is with ullmannite.——*Sychnodymite* is described by the same writer as a new cobalt-copper-sulphide from the Kohlenbach Mine, near Siegen, Prussia, corresponding to polydimite among the nickel compounds. The mineral occurs in little twinned octahedra of a darker color than those of polydimite. It is associated with quartz, tetrahedrite, and pyrite. Its density is 4.758, and composition:

S	Cu	Fe	Co	Ni	
40.645	18.984	.927	35.786	3.658	$=(CoCuNiFe)_4S_5$

Mineralogical News.—Honey-yellow or greenish-yellow crystals of *axinite* from Franklin, N. J., have an unusual tabular habit, with the P^1 face largely developed. They also contain several rare planes, well developed, and a new face, $\frac{3}{2}P^1{}_{\overline{3}}$. Their axial ratio is $a:b:c=$ 4921 : 1 : .4797, and $\alpha=82^\circ\ 54'\ 13''$, $\beta=91^\circ\ 51'\ 43''$, $\gamma=131^\circ\ 32'\ 19''$. Their specific gravity is 3.358, and composition:[9]

SiO_2	B_2O_3	Al_2O_3	Fe_2O_3	CuO	QuO	MnO	MgO	CaO	Ign
.76	42.77	5.10	16.73	.12	1.48	13.69	.23	18.25	.76.

Lamellar masses of the same mineral have a density of 3.306. Their composition does not vary much from that of the crystals. Crystals of the same mineral from Guadalcazar, Mexico, are associated with white feldspar. These are sage-colored. They are tabular parallel to ^1P, and their faces are frequently rounded. Granular scaly masses identical in character with the crystals yielded:

SiO_2	B_2O_3	Al_2O_3	Fe_2O_3	CuO	MnO	MgO	CaO	Ign
42.85	5.17	16.96	5.00	.19	9.59	.87	18.49	.75

[7] Miers. *Mineralogical Magazine*, IX., p. 1.

[8] *Zeits. f. Kryst.*, XIX., 1891, p. 12.

[9] Genth, Penfield and Pirsson. *Amer. Jour. Sci.*, May, 1891, p. 394.

The density of the crystals is 3.299. A small fragment of the same mineral from McKay's Brook, Northumberland Co., N. S., was not large enough for analysis.——Massive rose-colored *eudialite*[10] from Magnet Cove, Ark., has a specific gravity of 2.810. Analysis gave:

SiO_2	QuO_2	Ta_2O_5(?)	FeO	MnO	MgO	CaO	Na_2O	K_2O	Cl	Ign.
51.83	11.45	.39	4.37	.37	.11	14.77	13.29	.43	1.42	1.88

——*Sphene* occurs at Magnet Cove, in small brown or brownish-yellow crystals, associated with the constituents of elæolite-syenite. They are simple combinations of ∞P and –P.

SiO_2	TiO_2	FeO	MgO	CaO	Ign	Sp.Gr.
.57	30.84	39.35	.73	tr.	28.26	3.457

——At the same locality, in a coarse-grained calcite, are crystals and crystalline grains of *monticellite*, associated with crystals of magnetite and apatite. The habit of the rare mineral is short prismatic, with pyramidal terminations $\infty P\breve{\infty}$ and $2P\breve{\infty}$ largely developed (axial ratio $=.4337 : 1 : .5757$). The hardness is S; density, 3.108. The mineral, upon analysis, gave, as a mean of two sets of determinations:

SiO_2	Al_2O_3	MnO	FeO	MgO	CaO	P_2O_5	Ign
33.46	.17	1.12	5.01	20.61	35.24	2.03	2.28

deducting the P_2O_5 as apatite, which was present in the assay, the figures became:

SiO_2	Al_2O_3	MnO	FeO	MgO	CaO	Ign
35.14	.19	1.17	5.25	21.64	34.21	2.40

corresponding to $(Mg,Mn,Fe)_2SiO_4 + Ca_2SiO_4$.——A light-gray seleniferous *bismuthinite*, consisting of slender crystals imbedded in clay, yielded Genth:[11] $Bi = 77.54$; $S = 14.06$; $Se = 8.80$, corresponding to $4Bi_2S_3 + Bi_2Se_3$. It probably came from Guadalajara, Mex. Its density is 6.306. As the mineral was sent to the author as a specimen of *guanajualite*, an analysis of a specimen of this from an old German collection was made in order to discover whether or not it should be regarded as a distinct species. The examination resulted in the figures: $Bi = 68.86$; $S = 4.68$; $Se = 25.50$, corresponding to $Bi_2S_3 + 2BiSe_3$. ——Messrs. Melville and Luidgren[12] have contributed to our knowledge of the minerals of the Pacific slope some interesting observations in *cinnabar, metacinnabarite, struneyerite*, and a few other rare substances, among which are the recently described minerals *knoxvillite*

[10] Cf J. F. Williams. *Amer. Jour. Sci.*, Dec., 1890.
[11] *Amer. Jour. Sci.*, May, 1891, p. 402.
[12] Bull. U. S. Geol. Survey, No. 61.

and *redingtonite.* Cinnabar from the New Idria Mine, California, has a prismatic or rhombohedral habit, with the basal plane and a series of rhombohedra and tetarto-trapezohedrons well developed. The crystals are made up of layers of dextro- and lævo-rotatory material. At Knoxville acicular crystals occur with $-\frac{4}{5}R$, and ∞R. They encrust metacinnabarite that occurs in seams in a vesicular marcasite. An analysis gave: $HgS = 98.48$; $FeS = .69$; $SiO_2 = .71$. Analysis of redingtonite and knoxvillite yielded:

	SO_3	Al_2O_3	Cr_2O_3	Fe_2O_3	FeO	NiO	MnO	MgO	Res	H_2O at 100°
R.	35.35	5.14	7.51	.18	4.58	1.00	tr.	1.85	3.46	27.09
K.	35.91	4.84	7.41	15.36	3.81	.835		3.22	1.74	9.30

	H_2O above 100°
R.	14.34
K.	17.60

Copiapite in soft masses and sulphur-yellow scales and crystalline particles contains:

SO_3	Fe_2O_3	FeO	MnO	MgO	H_2O
39.97	26.54	.46	.21	3.06	30.43

Stromeyerite from the Silver King Mine, San Bernardino county, Cal., has a specific gravity of 6.28, a steel-gray color on a fresh fracture, and a composition: $Ag = 53.96$; $Cu = 28.58$; $Fe = .26$; $S = 15.51$; $Res = 1.55$. The rare chromium chlorite *Kotschubeite* is found in the serpentine at Green Valley, Cal., as thin, hexagonal plates arranged in rosettes. The plates are twinned monoclinic crystals, with an optical angle of about 30°, and an acute bisectrix nearly normal to oP. The type mineral from the Urals is in apparently hexagonal pyramids. The composition of the California mineral is:

SiO_2	Cr_2O_3	Al_2O_3	FeO	MiO	CaO	MgO
35.74	11.39	6.74	1.23	4.87	.183	35.18

Loss at 105°	Loss above 105°
.365	12.68

——In a note on some Canadian minerals Mr. Harrington [13] mentions the existence of *göthite* crystals, forming a velvety druse on hematite, calcite, and other minerals at Clifton, N. S. At the same place radiating needles of the iron compound are found capped with rhombohedra of calcite. One specimen yielded: $Fe_2O_3 = 88.92$; $Mn_2O_3 = .14$; $H_2O = 10.20$; $SiO_2 = .32$. A white to pale apple-green *serpentine* occurs as veins in a darker serpentine at an asbestos quarry near

[13] *Can. Record of Science*, Vol. IV., No. 2, 1890.

Coleraine, in the Eastern Townships. When first mined it is so soft as to be easily squeezed between the fingers, but on exposure it becomes harder until a hardness of 3.5 or more is reached. It then has a density of 2.514, and a composition : $SiO_2 = 43.13$; $MgO = 42.05$; $FeO = .37$; $H_2O = 13.88$, with traces of MnO, NiO, and CaO. Cinnamon *garnet* from Ottawa county, Ont., has a density of 3.58, and a rose-red *almandine* from the Laurentian gneiss at Murray Bay, Que., has a specific gravity of 2.59. Small red *spessartites*,[14] imbedded in the feldspar and muscovite of a coarse granite vein at Villeneuve Mine, Ottawa county, are much heavier. Sp. gr. = 4.117. The composition of these is :

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	Loss
Cinnamon	36.22	18.23	7.17		.63	37.39	tr.	.70
Almandine	37.97	22.44	2.39	26.12	1.18	5.27	5.42	
Spessartite	36.30	19.20		10.66	30.06	3.07	.43	.31

From the dump heaps of the Grant and Emerald Mines, in Buckingham, in the same county, specimens of mountain cork and mountain leather were obtained that yielded :

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	Loss	Sp. Gr.
53.99	.55	1.00	10.99	2.19	12.53	16.25	2.56	3.05

Since pseudomorphs of *asbestos* after pyroxene are found in the vicinity, it is thought that the material analyzed may be of the same nature. *Dawsonite* and *ittnerite* occur at the Corporation Quarry, on the west side of Montreal Mountain, and fine chalcedony concretions are imbedded in the clay between Irvine and the Cypress Hills, in the northwest territory.——The analyses of several minerals are given in a recent bulletin of the U. S. Geol. Survey,[15] among which the following are the most interesting : (1) *petalite*, from the spodumene locality at Peru, Me. ; (2) *spessartite*, from the Mica Mine, Amelia county, Va. ; (3) *willemmite*, Trotter Mine, Franklin, N. J. ; (4) *kaolin*, from the Waterfall Mine, Gunnison county, Col.

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	ZnO	CaO	Na_2O	K_2O	Li_2O	P_2O_5	H_2O and Loss
(1)	77.29	16.95	tr.	tr.				2.39	tr.	2.62		1.03
(2)	35.35	20.41	2.75	1.75	38.70		.94					.27
(3)	27.41					68.86						.25
(4)	47.28	36.19	tr.				.42	.51	5.74		.57	8.72

Triplite, from a tin mine near Rapid City, S. Dak., gave :

Al_2O_3	Fe_2O_3	FeO	MnO	CaO	Na_2O	P_2O_5	H_2O	F	SiO_2	Cl	CO_2
8.74	2.36	1.97	29.13	6.72	5.25	39.68	3.67	2.35	.43	.25	.26

besides traces of MgO and K_2O, and .13 per cent. LiO_2.

[14] *Can. Record of Science*, October, 1890, p. 225.

[15] Bull. No. 60, U. S. Geol. Survey, pp. 129–137.

ZOOLOGY.

Motion in the Protozoa.—Ryder has some interesting remarks on the contraction of the Vorticellid stalk[1] which has not before been properly understood. The muscle in the stalk is composed of alternating discs of anisotropic and isotropic matter, the former being in contact with the sheath on the inside of the coils, a type unknown elsewhere. Notes are also given on the motion of Trypanosoma.

Morphology of the Siphonophores.—Brooks and Conklin have recently studied[2] the reproductive organs of a Siphonophore belonging to Haeckel's order Auronectæ. The specimens came from near the Galapagos Islands, and were subjected to sectioning. The authors found only female organs, and are inclined to think that Haeckel's "androphores" some long, spindle-shaped gynophores filled with yolk, but into which the egg nucleus had not yet passed, or from which it has been forced out by pressure. The development of the gynophores is described, and the authors conclude that the "monovone gonophores" are true gonophores, while the "polyovone gonophores" are merely pouches containing ova, and are not, strictly speaking, gonophores. The attention is called to the fact that only male Physaliæ have been found, and the suggestion is made that in these two cases the other sex may be so different in form as to have been classed as a wholly different genus.

The Starfish Larva.—In a paper read before the National Academy of Sciences,[3] Dr. Brooks says that in numerous starfish larvæ taken at Wood's Holl, the water system is at first bilaterally symmetrical in every particular, although the right pore and pore canal early disappear. This is regarded as an additional argument for regarding the larva as ancestral, and attention is called to the similarity in ontogeny between the water pores of the starfish larva and the spiracles of Appendicularia and the tunicate tadpole.

Anatomy of the Synaptidæ.—Among the results derived from a study of the six species of Synaptidæ belonging to the genera Synapta, Chirodota, and Myriotrochus, Drs. Ludwig and Barthels conclude[4] that in the adult Synaptid there is no radial water canal; that

[1] Proc. Acad. Nat. Sci., Phila., 1891, p. 10.
[2] Johns Hopkins Univ. Circ., X., p. 87, 1891.
[3] Johns Hopkins Univ. Circ., X., p. 101, 1891.
[4] *Zool. Anzeiger*, Vol. XIV., p. 117, 1891.

semilunar valves constructed on the same plane are present in the tentacular canals; that a pair of auditory vescicles are present on each radial nerve where it emerges from the calcareous pharyngeal ring, and these are probably functional in the adult; the so-called eyes of *Synapta vittata* are undoubtedly sense organs, and the pigment spots in other forms are probably the same. These spots in *S. vittata* have a rich nerve supply.

Genito-Intestinal Canal in Trematodes.—S. Goto confirms[5] Ijima's account of a canal connecting the oviduct, in the ectoparasitic Trematodes, with the intestine. His studies have been made on eleven species representing four genera.

Fertilization in the Cestodes.—Pintner[6] has been very fortunate in finding two proglottids of *Anthobothrium musteli* in copula, 'and ascertained that a true cross fertilization was taking place. He also found another proglottid of the same worm in which the penis had entered very deeply the vagina of the same joint. These observations show that both close and cross fertilization occurs in these and possibly in all Plathelminthes.

Regeneration in the Oligochætes.—Miss H. Randolph has studied the reformation of the tail in Lumbriculus.[7] She finds that the processes are much like those of the growing embryo, except in regard to mesoderm. When fission occurs the violent contraction of the longitudinal muscles curves the ectoderm and entoderm towards each other, and then a union between the two is effected. The more rapid growth of the ectoderm produces the material for the proctodeum. The ectoderm gives rise to the ventral nerve chain and the lateral nerve line, and between these occur two other anlagen, which correspond in position to the ventral setæ and nephridia, but Miss Randolph has not traced them out. The mesoderm arises chiefly from large cells (neoblasts) in the region of the cœlomic epithelium of the ventral long muscles. These neoblasts represent the chorda cells of Semper, and occur in every segment except a few anterior. From these arise the embryonic mesoderm of the newly forming tail. It soon becomes arranged into a median and two lateral elements. The median becomes the ventral mesentery, and the walls of the ventral blood vessel; the lateral elements form all the lateral mesodermal structures except the circular muscles. These last arise from certain cells whose origin was not traced.

[5] *Zool. Anzeiger*, Vol. XIV., p. 103, 1891.
[6] Arb. Zool. Zool. Inst. Wien., IX., 57, 1890.
[7] *Zool. Anz.*, XIV., 154, 1891.

Distribution of Magelona.—Dr. E. A. Andrews calls attention[8] to the existence of the adult worm Magelona at Wood's Holl, and points out that the larva described by Fewkes from Newport as possibly the young of *Prionospio tenuis* in all probability belongs to this genus.

Budding in Polyzoa.—C. B. Davenport, contrary to Hatschek, says[9] that the stolonic mass in the Polyzoa arises from the ectoderm soon after the two-layered stage, the disc thus forming sinking below the general surface, and giving rise later to the first polypides. The cœlomic epithelium arises by a sort of ingression of a tissue to be probably regarded as mesoderm plus entoderm. In Paludicella each young polypide arises in the adult colony independently of any older polypide. It arises from a mass of embryonic tissue at the end of the branch, and some of this tissue is left behind each time the tip moves forward, and from this arise the lateral branches. As in the Phylactolœmata, the hinder part of the alimentary canal progresses from the anal toward the oral end. The œsophagus arises independently, and the two pockets fuse. The tentacles at first lie in two parallel rows o seven each, and the ectoproctous condition is not attained until the two free ends of the ring canal become confluent between mouth and anus. The so-called epistome described by various authors in early stages of Gymnolæmata has no relation with the similarly named structure in the other forms, but is merely the fold separating the brain cavity from the œsophagus. Eight laws of growth are formulated, based upon Bugula and Crisia as typical.

The Crystalline Style.—This problematical structure in the alimentary canal of many Lamellibranchs has recently been investigated anew by F. E. Schulze.[10] The idea that it is a supply of reserve food material is rejected by him, from the fact, among other reasons, that microscopic study shows it to be an epithelial secretion. He is rather inclined to the view that it, along with the mucous surfaces of the stomach, protects the intestinal walls by covering sand and other sharp particles with a layer of mucus.

The Position of Limulus.—Packard contiues his studies of the brain of Limulus.[11] He claims that the brain differs fundamentally from that of Arachnids, and is homologous with only that part of the scorpion brain which lies in front of the chelicral nerves. The his-

[8] Johns Hopkins Univ. Circ., X., p. 96, 1891.
[9] Proc. Am. Acad. Arts and Sciences, XXV., 278, 1891.
[10] S. B. Ges. Naturforsch. Freunde, 1890, p. 42.
[11] *Zool. Anzeiger*, X., 129, 1891.

tology is described, but is not easy to understand without figures. His conclusions are that the lack of homology between the brain of Limulus and Arachnids, the shape and grouping of the appendages, the absence of urinary tubes, of tracheæ, the presence of branchiæ, forbid the association of Limulus and its fossil allies with the Arachnids, although they may have had a common origin.

The Vertebrate Ear.—Dr. Howard Ayers, from a study of mammalian and sauropsidan ears, concludes [12] concludes that the so-called membrana tectoria of the mammalian cochlea is not a membrane which acts as a damper on the organ of Corti. He rather regards it as an artifact produced from the very long sense hairs of the cells of the cortian organ. The membrana basilaris further is not a vibrating membrane. "The physiological unit of the cochlea is a sensory hair-bearing epithelial cell; the anatomical unit of the cochlea is a group of hair-bearing and supporting cells,—*i. e.*, a sense organ comparable in a word to an ampullar sense-organ." Full details are promised immediately.

Segmentation of the Vertebrate Head.—B. H. Waters thinks [13] that the neuromeres of Beranek and others may be traced into the mid- and fore-brains of Amblystoma and the cod, and he would recognize three neuromeres in the fore-, two in the mid-, and six or five in the hindbrain. The optic nerve is given a segmental value.

Description of a New Species of Catostomus (C. rex) from Oregon.—One specimen, thirty-two inches long, from Lost River, Tule Lake, Oregon, was added last year to the collection of the California Academy of Sciences. The characters are as follows: D. II., 11½; A. II., 6½. Scales, 13–80–8; about 35 before the dorsal. Head, 4; depth, 4. Eye, 8 in head, placed but little posterior to the middle, the snout about 2¼ in head. Head broad, flattish, the cheeks sunken and very long. Mouth small, lower jaw strong, the maxillary spine forming a hump on the snout. Papillæ small, apparantly but two rows on upper lip. Scales peculiar, the basal portions covered with skin. Ventrals rounded, placed below anterior half of dorsal, not reaching halfway to vent. Dorsal as high as long, angular, the last rays but little shorter than the anterior, inserted midway between tip of snout and base of middle caudal rays. Pectorals reaching halfway to ventrals. Caudal peduncle subterete, long. Anal just reaching to caudal. Lateral line interrupted posteriorly. Pharyngeals

[12] *Anatom. Anzeiger*, VI., p. 219, 1891.
[13] *Zool. Anz.*, XIV., 141, 1891.

narrow, the teeth gradually narrower from below upward. Blackish to below the lateral line, many of the scales of the ventral surface dark dotted. Fins blue-black, the paired fins darkest.—R. S. EIGENMANN.

The End of the Urodele Tail.—It has long been known that in the tritons the skeleton of the tail terminates not by a vertebral body, but by a "cartilaginous end rod." This has been said to have no genetic connection with the notochord. Now Barfurth,[14] in studying regeneration in this region, finds that the chorda cells are capable of regeneration in the Urodeles, and that the chorda cells become altered into this terminal element, which he prefers to call "chorda-rod."

The Gila Monster.—Mr. Samuel W. Garman has recently studied[15] a living specimen of this reputedly venomous lizard. It was fed on eggs. It made its burrow in the sand in the box in which it was kept, and it evinced great desire to bask in the sun. It was "really good natured," although it could be teased into a temper. Mr. Garman is very doubtful of its deadly qualities. The venom seems to affect small animals, but to have little danger for larger ones. Several of the well-known accounts of its noxious character are quoted, and then Garman details his own experiments with a cat, less than one-third grown. This the "monster bit twice on the hand and wrist. For half an hour this caused the kitten some distress, and was licked and dressed as usual. Then followed an hour and a half of sleep, from which the kitten woke as bright as ever, the hand being slightly swollen, and in twenty-four hours no ill effects were seen. The same kitten was then bitten again, and later the wounds were studied, but no disintegration or other modifications of the tissue were visible."

Dr. R. W. Shufeldt, in the New York *Medical Journal* of May 23d, 1891, gives a summary of observations made up to date on the structure of the salivary glands, and the effects of the saliva when introduced into wounds. He concludes that the evidence is conflicting. Three good figures accompany the paper.

Recent Researches in the Herpetology of Africa.—The Société Philomatique of Paris has recently published several papers by M. F. Moquard on reptiles and Batrachians from Africa that will interest zoologists, as they come from regions but little represented either in museums or private collections. In the memoir on the rep-

[14] *Anatom. Anzeiger*, VI., 104, 1891.

[15] Bulletin Essex Institute, XXII., p. 60, 1890 (1891).

tiles from Somali and Zanzibar[16] the author prefaces his descriptions with the following remarks :

"The new collection of reptiles and batrachians reported in 1884 from the Somali country and Zanzibar, by M. G. Revoil, is without doubt the most important of all those which this zealous traveler has sent to the museum during many excursions into regions at that time almost unknown. One of these collections was described many years ago by Professor L. Vaillant. This new one, richer in species, is distinguished by some specific types and interesting genera which appear to be new. Among these types we cite in the Lacertilian order *Hemidactylus tropidolepis*, the dorsal aspect of which is covered with unequal, keeled scales, and not with granulations, as appear upon many of the species of Hemidactylus, or with equal, smooth scales, as *H. homœolepis ;* an Eremias with nostril opened between four nasal plates, and with the dorsal scales keeled, which I have dedicated to Professor Alph. Milne-Edwards, *E. edwardsii ;* a new species of Agamodon, *A. compressum*, characterized by a compressed body and by having the lateral borders of the cephalic shields recurved.

"Besides the new species of Dasypeltis, of slender form, *D. elongata*, the Ophidians contain two Calamarians which we believe represent new genera, the one a relation of Elapomorphus, but without the malar or preorbital constitutes the genus Elaposchema, a name which will suggest its resemblance to Elaps ; the other, slightly removed from Amblyodipsas, and to which I would give, on account of its size, the name Brachyophis, is especially remarkable for the presence of a true occipital plate behind the parietals. It seems proper to dedicate these two new species, *Elaposchema vaillantii* and *Brachophis revoilii*, respectively to M. Vaillant and M. Revoil.

"Among the species already described, but which until now have remained in the museum we cite the following: *Agamodon anguliceps* Peters, *Psammophis biseriatus* Peters, and *Chiromantis petersii* Boulenger ; the first is represented by nine specimens, and the last two each by two.

"In concluding this short introduction, we call attention to the fact that two of the new species of which we have spoken above are burrowers,—*Agamodon compressum* and *Brachyophis revoilii.* One readily believes that other types of similar habits of life, and which have hitherto escaped the researches of explorers, will be found to enrich

[16] On a Collection of Reptiles and Batrachians sent from Somali and Zanzibar. By M. G. Revoil. Memoires Publiés par la Société Philomatique à l' occasion du Centenaire de sa Fondation, 1788-1888.

the herpetological fauna of Eastern Africa whenever a thorough search can be made."

The collection includes thirty-four species, of which twenty are lizards, twelve are snakes, and two are batrachians. Two plates, admirably drawn, accompany the paper, giving in detail the curious appearance of the three new species.

The other papers contain a description of a new snake (*Atractaspis leucura*) from Assinie ;[17] a review of the genius Heterolepis, with the addition to it of three new species,—*H. stenophthalmus*, *H. guiralii*, *H. savorgnanii* ;[18] and descriptions of snakes[19] and reptiles[20] from the Congo country.

Of the latter, M. Mocquard described thirty-four species, four of which are new,—*Microsoma fulvicollis*, *Coronella longicauda*, *Atheris anisolepis*, and *Gonionotus brussauxii*.

EMBRYOLOGY.[1]

Development of Compound Ascidians.—Dr. M. v. Davidoff has published a second contribution to the above subject, entitled "Untersuchungen zur Entwicklungsgeschichte der Distaplia magnilarva, etc."[2] He deals here with the general formation of the germ-layers. The paper runs through more than a hundred pages, and the author by no means confines himself to the title of the paper, but discusses the development of all other Ascidians, the problem of the mesoderm formation, and touches upon the origin of the vertebrates themselves. The holoblastic segmentation of the egg is described for the earlier stages. The most interesting fact in this connection is the presence of the *test cells* between the segments of the egg for quite a long time during the early stages. Subsequently they disappear, presumably degenerating. A solid mass of cells results from the segmen-

[17] Sur une nouvelle espèce d'Atractaspis (*A. leucura*). Ext. Bull. de la Société Philomatique de Paris Séance du 28 Novembre, 1885.

[18] Du genre Heterolepis et des espèces qui le composent dont trois nouvelles. Ext. Bull. de la Société Philomathique de Paris, October, 1886.

[19] Sur les Ophidiens rapportés du Congo par la Mission du Brazza. Ext. du Bull. Soc. Philomathique de Paris. Séance du 18 Dec., 1886.

[20] Sur une Collection de Reptiles du Congo. Ext. Bull. de la Soc. Philomathique de la Paris, 8 serie, t. 1, No. 4, page 143.

[1] Edited by Dr. T. H. Morgan, Johns Hopkins University, Baltimore, Md.

[2] Neaples Mittheilungen, IX. Band, IV. Heft.

tation, those over one pole being very large, and are, as shown by their fate, the endoderm cells, while those at the other pole go to form the ectoderm. Both germ-layers are filled with large yolk masses. The ectoderm cells partially surround the endoderm cells. Where ectoderm and endoderm come in contact around the periphery of the large, open blastopore there is found a ring of small ectoderm cells, which go to form the nerve-chord of the older larva. It is thus seen that the nerve-chord is formed from two bilateral parts lying along each side of the blastopore, then subsequently coming into contact form the nerve plate. Before the blastopore is closed in, however, the large endoderm cells, which are still at the surface (within the rim of the ectoderm forming the blastopore lips) delaminate into a row of outer, smaller cells—the endodermal plate—and larger cells in the interior of the embryo. From the former there develops, at the sides of the blastopore, the peristomial mesoderm. Later, as said above, the lips of the blastopore close over the endodermal plate, and the nerve-chord is formed out of the cells from the two sides of the blastopore meeting over the endodermal plate. *It is thus seen that the blastopore corresponds to the dorsal side of the embryo.* In other words, the animal pole of the eggs, where the ectoderm first forms, corresponds to the ventral side of the Ascidian, and by inference to the ventral side of all Chordata. (Van Beneden had previously pointed out this fact, which is of the greatest importance, since it bears directly upon two of the most interesting problems of embryology,—viz., the relation of vertebrates to other groups, and the polar relations of the egg to the adult animal.) There is no invaginate gastrula in Distaplia, andt he cavity of the digestive tract appears later as a split in the endoderm. After a review of gastrula within the group, the author concludes as follows: "Segmentation in the *solitary* Ascidians is nearly equal, and leads to a one-layered blastula, of which one-half flattens, then invaginates. By this means there is formed a gastrula which comes nearest of all Ascidians to the primitive type,—*i.e.*, to a Archigastrula. In the *social* Ascidians a modification is brought about in that the blastula is not formed. With the disappearance of the latter the segmentation-cavity is reduced to a split between the embryonic cells, or fails completely. The result of segmentation is a two-layered plakula, into which the elements of the two germ-layers differentiate quite early,—at the eight-celled stage. The gastrula is here formed not by invagination of blastoderm cells, but by a splitting in the endoderm, while the borders (periphery) of the plakula rise up and grow towards one another,—a process that is brought about by unequal growth (increase)

of the cells of the two germ-layers, and is to be distinguished from the true invagination (embole) as pseudoembole.

"The development of the *compound* Ascidians is easily distinguished from that of the social Ascidians. Here the plakula turns in by another process, since the gastrula-cavity (which formed the archenteron in Clavellina) is filled in the dorso-ventral direction with dividing endodermal cells. Now the archenteron arises neither by embole or by pseudoembole but by delamination of the large endodermal cells (*Distaplia amaræcum*). The closing over of the endoderm by the ectoderm takes place in Distaplia by a different process in different parts of the embryo; anteriorly it is purely epibolic; posteriorly, on the other hand, this takes place by a division of the dorsal endoderm cells (endodermplate), which at the same time, together with the ectoderm cells in question, grows around a space (pseudogastrula-furrow), which space is later filled by the endodermal cells themselves. This process, taking place in the pseudoembolic region of the embryo, must be lo .ed upon as a rudiment of embole, which, in spite of great changes in the egg of social Acidians, occurs in the typical way."

This series of stages, from the simple to the social, to the compound Ascidian, furnishes an excellent example of Hatschek's law that "by a phyletic change in a group of animals not only the adults (end stage) are changed, but also the whole series of embryonic stages, from the egg to the adult (end stage.)

Rabl's phylogenetic classification of the vertebrates according to the accumulation of yolk is criticised and objected to. We need not here enter into the detailed description of the origin of the mesoderm, the digestive tract, and the notochord, which occupies the last fifty pages of the paper.

Development of the American Lobster.—Two preliminary papers, one on the habits and larval stages of the lobster, and the other on the reproductive organs and early stages of the lobster, have been published by Prof. F. H. Herrich.[3] "The spawning season is confined to the summer months, and the eggs which are then laid are carried by the female throughout the fall, winter, and spring, and are not hatched under natural conditions until the following summer." The number of eggs laid varies from about 3,000 to 36,000; a lobster 10½ inches long produces on an average 12,000 eggs. The lobster does not breed annually. The eggs laid in summer develop with comparative rapidity, and eye pigment is formed in 27 to 30 days. Development slows up in the fall, and comes nearly to a standstill in the

[3] Johns Hopkins University Circular, No. 87, 1891.

winter. Soon after hatching a brood the lobster may moult, but eggs are not laid again until at least another year.

When the young lobster hatches from the egg it moults, and in artificially hatched lobsters large numbers die on account of inability to pass this moult. After six or seven days the second moult occurs. Young lobsters swim at the surface six to eight weeks, and then disappear entirely from the surface.

The second paper deals with the growth of the reproductive organs, and the stages as far as the nauplius-like condition. The greatest differences appear in the segmenting eggs. The egg nucleus, with its surrounding protoplasm divides near the center of the egg, and its products wander to the surface, and the periphery breaks up into irregular cells. Until about 40 hours after fertilization the peripheral yolk is entirely segmented. About 30 segments are present. In all the segmentation stage occupies three days. By the end of the fourth day the invagination stage is reached. This is followed by the keel stage, which lasts about four days. At the beginning of the tenth day the nauplius appendages begin to bud, first the first pair of antennæ and mandibles together, and a little later the second pair of antennæ.

ENTOMOLOGY.

The "Arrow Weed" and Mexican "Jumping Bean' Insect.—It has long been known that the Indians in Mexico make a powerful poison from some native plant, which poison, in a milder form, is also used as a cathartic. It has also long been known that seeds possessing the curious power of jumping are produced upon the same plant in Mexico, and are sent to other parts of the world, forming quite an article of commerce. The exact nature of this plant, however, has hitherto remained a mystery. At a recent meeting of the Washington Entomological Society, Professor C. V. Riley read an interesting paper on the determination of the plant upon which these "jumping seeds" are produced. In the Transactions of the St. Louis Academy of Sciences for 1875 is an account of *Carpocapsa saltitans* Westwood, the insect which causes the saltation of the "beans," he had called attention to the fact that the particular euphorbiaceous plant upon which these seeds are produced was not determined. Westwood, in his original description of *Carpocapsa saltitans,* states that the plant is known to the Mexicans as Calliguaja, and in a recent

letter to Prof. Riley from M. Chretien, of the French Entomological Society, the plant was referred to as a Mexican euphorbiaceous plant called *Colliguaja odorifera* Moline. About this time Mr. J. M. Rose, of the botanical division, brought to Prof. Riley specimens of plants recently collected by Dr. Edward Palmer, who sent with the plants specimens of the capsules, thus rendering it certain that the jumping bean occurs on this particular plant. It turns out to be undescribed, has been referred to the genus Sabastiania, and will be described by Mr. Rose as *S. palmeri.* Prof. Riley decides that the reference given by M. Chretien is erroneous, as Bentham and Hooker give *Colliguaja odorifera* as from South America, and there is no record of it from Mexico. Comparison of the specimens in the department herbarium showed that while evidently closely allied, Colliguaja is quite distinct from Sebastiania, which renders it rather remarkable that the name given by the Mexicans to the plant should be identical with that adopted for the South American genus. The name seems to be of Chilian origin, and was doubtless introduced into Mexico by the Spaniards. It is probably applied to various euphorbiaceous species having the same poisonous attribute, whether occurring in Mexico or south of the equator.

A closely allied species of Sebastiania from the same localities (as yet undescribed, but which Prof. Watson will describe as *S. pringlei*) also shows evidence of being infested with *Carpocapsa saltitans*, and a third species (*S. bilocularis*) is infested by an allied larva of a moth which Prof. Riley describes by the name of *Grapholitha sebastiania.* There is therefore good evidence that the insect causing the saltations of the "beans" develops in the capsules of at least two different species of the genus Sebastiania. The young larva doubtless hatches from an egg laid externally on the capsule, and penetrates the same while quite young, very much as in the case of the common pea weevil. Dr. Palmer found *S. palmeri* only in certain cañons near Alamos, where it is popularly known as *palo de la flecha cuero de las simellas brincaderos* (arrow tree which produces the jumping beans). The plant exudes a good deal of milky juice, which is what the Indians use on their arrow-heads. It is a loose-growing shrub, from five to eight feet high, the wood very hard, and the milky juice readily crystallizing into a clear, white, brittle substance. In the appearance of the wood it reminds one somewhat of our witch-hazel, and in the leaf of a broad-leaved willow. As in the case of other Euphorbiaceæ, the carpels, or each of the three parts of the capsule, dehisce, or suddenly split when ripe; but when the larva inhabits the same the parts fail to

separate, being kept together by the carpet of silk which the larva spins on the inside. The peculiar jumping motions of the carpel are thus produced, as first described by Prof. Riley in the Transactions of the St. Louis Academy aforementioned. The full-grown larva, by its holding fast to the silken lining by its anal and two hind pair of abdominal pro-legs, which have very strong hooks, then draws back the head and fore body, the thoracic parts swelling and the thoracic legs being withdrawn. The contracted parts being then suddenly released, the larva vigorously taps the wall of its cell with its head, sometimes thrown from side to side, but more often brought directly down as in the motion of a wood-pecker when tapping for insects. The seed will thus move whenever warmed for several months during the winter, because, as with most tortricid larvæ, this one remains a long time in the larval state after coming to its growth and before pupating.

Remarkable as are the movements of this seed, Prof. Riley remarked that they are thrown into the shade by a little jumping gall produced on the leaves of our post-oak and other oaks. This is a little, spherical, seed-like gall, and the insect within, which produces the fly known as *Cynips saltatorius*, can make it bound twenty times its own length. Here the motion is imparted by the insect in the pupa, and not in the larval state.—*Scientific American, June 13th, 1891.*

ARCHEOLOGY AND ETHNOLOGY.[1]

The International Congress of Anthropology and Prehistoric Archeology of Paris, 1889.—(*Continued from page 592*).

Fifth Question : "The Relation Between the Civilization of Hallstadt and Other Danubian Stations, and those of Mycenæ, Tirynthe, Hissarlik, and the Caucasus."

This question brought up the most excited, because the only personal, discussion of the congress. Captain E. Boetticher presented a paper criticising the excavations made at Hissarlik by M. Schliemann. Captain Boetticher was of opinion that the hillside of Hissarlik which had been explored by M. Schliemann did not contain, as M. Schliemann thought, the dèbris of the walls or the temples or palaces, but that it had been a necropole or crematory, a place for incineration or cremation, and that the superposed territory contained the cinerary

[1] Edited by Dr. Thomas Wilson, Smithsonian Institution, Washington, D. C.

urns and other objects which related exclusively to funeral and burial customs. That, said he, which M. Schliemann took for walls of defense or habitation were nothing but the surrounding walls of furnaces where incineration had been practiced. The tumulus of Troade, he contended, had the same origin as that of Hissarlik. Its civilization was, according to him, essentially Assyro-Babylonian, influenced in a large measure by the Phœnicians and by the Egyptians. About 1500 years B.C. the civilization of which Troy may have been the center extended over a part of Asia Minor and into Western Europe. It was destroyed by the Hellenes that substituted for it the classic civilization. Hissarlik, Mycenæ, Tirynthe, Koban, and Hallstadt are the principal stations of this now destroyed and disappeared civilization. Captain Boetticher enumerated his proofs, and insisted upon the analogy between the objects of Italy and those which had been gathered in Egypt, in Assyria, and in the north of Europe, and of which the destination, said he, was essentially votive and funeral.

Dr. Schliemann rose, and, according to the official report made by the secretary, he was saluted by an ovation which was entirely exceptional in a scientific congress. Although a German, he spoke French with facility, and I may remark, English equally well, and he expressed himself with a vivacity which sometimes attained almost violence, in his interesting and excited reply to the attack of Boetticher. He commenced with a historic résumé of his excavations, of his first visit to Troad in 1868. He recalled the fact that, disdaining all traffic and commercial profit by the sale of the classic antiquities which he there discovered, he had given to the museums in his native country and others all the products of his research. He gave due credit to his aids and assistants, of whom stood in the first rank his wife, a French engineer, Adolphe Laurent, Emile Burnouf, director of the French School at Athens, Joseph Holfor, the architect, of Vienna, Dr. Virchow, and Dr. Doerpfeld. He acknowledged an international concert of praise of which any man, scientific or not, had just right to be proud. The attacks of Boetticher had been responded to by Virchow and Doerpfeld. The latter offered his services to accompany Boetticher to Troy, and there take up the excavations, and M. Schliemann declared his willingness that the whole should be done at his expense. Dr. Schliemann then took up the details of the discussion. He declared that M. Boetticher made choice of exceptions out of an enormous series or mass of material. He replied to attack after attack with apparent satisfaction and success. He extended his remarks, and compared in detail the antiquities of Troy with those of Mycenæ, of

Tirynthe, and Orchomene, and saying that their civilization had become general in Greece at an epoch approximate with the seventh century B.C. He concluded with a rapid summary of art and industry since that time.

Monsieur Montelius then spoke, and arranged himself solidly upon the side of Schliemann and against Boetticher. He had visited Italy, and had there seen what to him were indisputable traces of a town, —rather of several towns superposed. He expressed his belief that it might yet be found that the tomb of Mycènes and the palace of Tirynthe belonged to the age of bronze; but he concluded with a compliment and expression of confidence to Dr. Schliemann that he had formed a veritable era in the study of preclassic civilization and archeology.

M. J. de Morgan spoke of the antiquities found at Hissarlik by M. Schliemann. He declined to enter into the discussion of the differences between Dr. Schliemann and Capt. Boetticher. So far as concerned those differences, he was decidedly upon the side of Dr. Schliemann, and if he had any difference of opinion of his own with Dr. Schliemann, it was rather that from his knowledge and his excavations in the Armenian and Chaldean countries, and those farther to the east than that of Italy,—it was to say that he thought Dr. Schliemann had made the error of assigning too recent a date rather than too ancient a one. M. de Morgan recalled the numerous evidences of the knowledge of iron in Asia at times of high antiquity. The necropoles of Warka and Mougheir, in Chaldea, were at least thirty centuries B.C., and yet were in the beginning of the age of iron in that country. At 1700 B.C. the Egyptian generals returned from their campaigns in Asia bringing with them utensils of iron, to which they attached great value in view of the rarity of that metal in the valley of the Nile. At the beginning of the Assyrian empire iron had already become a metal in current usage throughout that part of Asia. M. de Morgan enumerated the evidences and indicated generally the locality of the people of which he spoke. Now, said he, these people were in contact with the inhabitants of Troad, and therefore the latter ought to have had a knowledge of iron, and by reason. The evidence of their commerce and their contact with these people is undisputable, and according to all archeology and history they certainly had a knowledge of and acquaintance with iron. If the excavations made in the Troad or at Hissarlik contained no evidence of iron, it is because of one of two things: either the investigation has not been sufficient to obtain all the evidences which there existed, or else the epoch to

which the excavations related were at an earlier period than that indicated as having had a knowledge of iron. With our knowledge of investigations of Dr. Schliemann one cannot suppose the first exception to have existed. The investigations were sufficiently profound, sufficiently extensive, to satisfy one that if iron had had an existence at that time in that locality, he would have found its evidence; and this was evidence or proof, said M. de Morgan, that the inhabitants of Hissarlik did not at that time possess knowledge of iron. The other conclusion must then prevail, to wit: that the excavations at Hissarlik made by Dr. Schliemann pertain to an epoch when iron was not known or used by the inhabitants; and by this line of reasoning he demonstrated to his own satisfaction the error of Dr. Schliemann having assigned to Hissarlik a period too recent, when it should have been more ancient. M. de Morgan said that a study of the mines, whether of iron or of copper, and all the excavations in the neighborhood with which he was acquainted, confirmed the teachings of history, and he thought he had correctly laid it down. In Russian Armenia the excavations told the same story. M. de Morgan said he had opened more than a thousand sepultures, all of which contained arms of iron, which belong or could be divided into two simple groups: one of which was anterior to the eight century B. C., the beginning or duration of which was as yet unknown, but which might have been very much older than the date mentioned; the other was posterior, after the grand invasions of the seventh century B C., but before the Persian conquest. The age of bronze, said M. de Morgan, if in existence of to be found in the Transcaucasie, was of comparatively short duration; and therefore, ranging himself upon the side of Dr. Schliemann and against Captain Boetticher, he demanded, is it possible that the whites of the Ægean sea, who were always moving from one place to another, who were eminently the people of migration, of commerce, of travel,—is it possible for these to have remained without knowledge of iron while that knowledge was spread around them upon every side? and his response to his own question was that it was not possible. His conclusion was, as stated, that if the people of the east had knowledge of iron at this epoch, the people of Hissarlik would have it the same time, and as the investigations of Schliemann shows no object or industry in iron, therefore his excavations pertains to a period earlier than he had claimed.

This question was of deep interest to me. At my department in the National Museum we had just obtained a series of the tombs and their contents, the evidences of human industry (a very fine series), and

which had been discovered and excavated by the Brothers de Morgan in Armenia. These were objects from some of the thousand sepultures mentioned by M. de Morgan, and they came from the mountain range midway between the Caspian and the Black Seas. So these objects both of bronze and of iron mentioned by him were quite familiar to me.

Monsieur A. Odobesco presented some observations and descriptions as to the prehistoric monuments in Roumania, in Northern Moldavia. He described the objects of human industry as being arms made of polished stone implements in gold, objects in pottery. Some of the latter were covered with designs in color which resembled the volutes, spirals, and cervides of the vases of Mycenes. There were also small statuettes in terra-cotta. Monsieur Odobesco believed that the prehistoric stations of this sort in Roumania, Valachia, Transylvania, belonged to the same chain of civilization which had its origin in Greece and Asia Minor and united the prehistoric Caucasus, and he recommended the attention of the congress to this matter at some future session. Thus was brought to an end the extremely interesting and somewhat exciting discussion between Dr. Schliemann and Captain Boetticher. (*To be continued.*)

Recent Discoveries of Egyptian Remains.—Writing to the New York *Nation* from Keneh, Upper Egypt, on March 17th, Mr. W. H. Goodyear describes an important and most interesting discovery made by Mr. Petrie at Maydrom. Mr. Petrie has there unearthed "the oldest known Egyptian temple, and the only pyramid temple ever found." Apart from the "Temple of the Sphinx" at Ghizeh, this building is also "the only temple of the Old Empire so far known." It was buried under forty feet of rubbish. It lies directly at the center of the eastern base of the pyramid, on the side facing which it has two round-topped obelisks. "Obelisks and temple chambers so far entered," says Mr. Goodyear, "have the plain, undecorated style of the Old Empire, as shown by the temple of the Sphinx, but hieratic inscriptions in black paint found within fix the name of Seneferoo as builder, and confirm the supposition to this effect hitherto based on the fact that tombs near the pyramid contain his cartouche. Seneferoo is the king connecting the third and fourth dynasties, and variously placed in either. According to computations of Mariette and Brugsch, the antiquity will be about 4000 B.C., or earlier. On Tuesday, March 10th, Mr. Petrie's workmen reached a platform which appeared to be a causeway terminating with two obelisks at the base of

the pyramid." "In the forenoon of Wednesday," continues Mr. Goodyear, "a workman came to say that an opening had been found under the platform on the side next the pyramid. This proved to be the top of a doorway choked by detritus, through which Mr. Petrie crawled into an interior of three chambers, and discovered the inscriptions mentioned. I had the pleasure of following him. Mr. Petrie thought the apartments had not been previously entered for about three thousand years,—that is to say, that the rubbish fallen from the pyramid had choked the entrance about three thousand years after construction. A friend who was with me noticed on the floor some dried wisps of papyrus, a plant now extinct in Egypt. The chambers thus far found are so filled that one cannot stand erect in them, and a door at the end of the third chamber is blocked by large stones. Over all lies an enormous mass of detritus, whose removal by Arab diggers is now progress. I had the pleasure next day of carrying the news of Mr. Petrie's find to the gentlemen of the Egypt Exploration Fund at Beni-Hassan, and of witnessing their unaffected delight over it."—*Scientific American, May 23d, 1891.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The Royal Society of Canada.—This body met at Montreal, from May 27th to June 1st, inclusive. The officers were as follows: Honorary president, Lord Stanley de Preston; president, Rev. Geo. M. Grant; vice president, Abbe J. C. LaFlamme; honorary secretary, J. G. Bourinot; honorary treasurer, Dr. A. R. C. Selwyn. The following papers were read in the department of geology and biology:

"On the Probable Occurrence of Gold-Bearing Rocks in New Brunswick." Prof. L. W. Bailey. "Notes of the Pleistocene Plants of Canada, with Descriptions of New Species from the United States." Prof. D. P. Penhallow, B.Sc. "The Geological Formation of Quebec, South of the River St. Lawrence." R. W. Ells, LL.D., F.G.S.A. Communicated by J. F. Whiteaves. "On the Present State of Botany in the Dominion of Canada, with Suggestions as to Promising Lines of Investigation, and a Proposal for United Effort in Systematic Observation throughout the Several Provinces and Territories." George Lawson, LL.D. "Note on Carboniferous Batrachians." Sir Wm. Dawson, F.R.S. "Parka Decipiens—Notes on Specimens from the Collections of James Reid, Esq." Sir Wm. Dawson, LL.D., F.R S., and D. P. Penhallow, B.Sc. "Hibernation: A Preliminary Communication." Prof. Wesley Mills, M.A., M.D. "The Orthoceratidæ of the Cambro-Silurian Rocks of Manitoba." J. F. Whiteaves, of the Geological Survey. "The Ammonites of the Cretaceous Rocks of the Valleys of the Peace and Athabasca Rivers." By the same. "On the Geology of the St. Claire Tunnel." Frank D. Adams, B.A.Sc. Communicated by Sir Wm. Dawson. "Observations on the Distribution and Habits of Some New Brunswick Fishes, including New Forms Lately Identified. Philip Cox, A.B., B.Sc., Newcastle, N. B. Communicated by Prof. Bailey. "Illustrations of the Fauna of St. John Group, No. VI." G. F. Matthews, M.A. "Three Deep Wells in Manitoba." J. B. Tyrrell, M.A., B.Sc. Communicated by Dr. G. M. Dawson. "On the Sequence of Strata Forming the Quebec Group of Logan and Billings, with Remarks on the Fossil Remains Found Therein." Henry M. Ami, M.A., F.G.S., of the Geological Survey of Canada. Communicated by Dr. G. M. Dawson. "Descriptive Notes on Certain Implements, Weapons, etc., from Graham Island, Queen Charlotte Islands, B. C." Alex. MacKenzie. Communicated by Dr. G. M. Dawson.

SCIENTIFIC NEWS.

The American Society of Microscopists.—This association, now in the thirteenth year of its existence, will hold its fourteenth annual meeting in Washington, D. C., August 10th, and continue in session five days. Its roll of active members contains about three hundred and fifty names, embracing very nearly every person in the United States who is at all prominent as a microscopist. Its membership consists of two distinct classes,—viz., professional men and students of the natural sciences, who use the microscope in their daily avocations as an instrument of research, diagnosis, or precision; and amateurs, or those who find pleasure and profit in the revelations of the instrument. Many of the latter class, from having early chosen special lines of study and investigation, have acquired high reputations in their respective departments of microscopical research. In its earlier years this class predominated in the membership of the society, but at present the professional element is largely in excess.

The sixty-first meeting of the British Association for the Advancement of Science will commence on Wednesday, August 19th, 1891, at Cardiff, Wales, under the direction of the following officers: President elect, William Huggins, Esq., D.C.L., LL.D., F.R.S., F.R.A.S.; vice presidents elect, The Right Hon. Lord Windsor, Lord Lieutenant of Glamorganshire; The Most Hon. The Marquis of Bute, K.T.; The Right Hon. Lord Rayleigh, M.A., D.C.L., LL.D., Sec.R.S., F.R.A.S., F.R.G.S.; The Right Hon. Lord Tredegar; The Right Hon. Lord Aberdare, G.C.B., F.R.S., F.R.G.S.; Sir J. T. D. Llewelyn, Bart., F.Z.S.; Archibald Geikie, Esq., For.Sec.R.S., F.R.S.E., Pres.G.S., Director-General of the Geological Survey of the United Kingdom; general treasurer, Prof. A. W. Williamson, Ph.D., LL.D., F.R.S., V.P.C.S., 17 Buckingham Street, London, W. C.; general secretaries, Captain Sir Douglas Galton, K.C.B., D.C.L., LL.D., F.R.S., F.L.S., F.G.S., F.R.G.S.; A. G. Vernon Harcourt, Esq., M.A., D.C.L., LL.D., F.R.S., F.C.S.; assistant general secretary, G. Griffith, Esq., M.A., F.C.S.; local secretaries for the meeting at Cardiff, R. W. Atkinson, Esq., B.Sc., F.C.S, F.I.C.; Prof. H. W. Lloyd Tanner, M.A., F.R.A.S., Bank Buildings, Cardiff; local treasurers for the meeting at Cardiff, T. Forster Brown, Esq., M.Inst. C.E.; Henry Heywood, Esq., J.P., F.C.S.

Ogden N. Rood, A.M., Professor of Physics in Columbia, says: "No member of this department is engaged in any commercial or outside work whatever. There is one feature of work in which some college professors are accustomed to indulge, which cannot be too strongly condemned. That is when a man under salary from a great university, trading on the name and fame of the institution, holds himself in readiness to testify as expert witness for a pecuniary consideration. This practice, I take it, is one which ought to be discouraged by the authorities of the colleges where it exists. The time of a college professor should be devoted to teaching and to original research, to the interests of the students, and to the advancement of science. The office should not be prostituted in such a manner by self-seekers and mercenary men. There is, so far as I know, only one institution where this practice is not known: that is at Johns Hopkins. The only reason that makes such expert testimony valuable in the eyes of the jury is the fact that the witness is an officer in a prominent institution of learning, and this looks, to me, like trading in the reputation of the college, and, to say the least, is a great breach of good taste."—*Scientific American, May 23d, 1891.*

Edmond André, the well-known student of the Hymenoptera, died in Beaune, January 11th, 1891.

Dr. Oscar Schultze is called to be extraordinary professor in the University of Würzburg.

Dr. Lewis E. Hicks, for the past six years professor of geology in the University of Nebraska, will leave his position at the close of the college year.

Dr. Dostoiewsky has been elected prosector of histology and embryology in the Medical School of St. Petersburg.

Antonio Stoppani, the Italian geologist, died January 1st, 1891.

Dr. Gustav Retzius, well known for his classic work on the vertebrate ear, has resigned his position in the University of Stockholm.